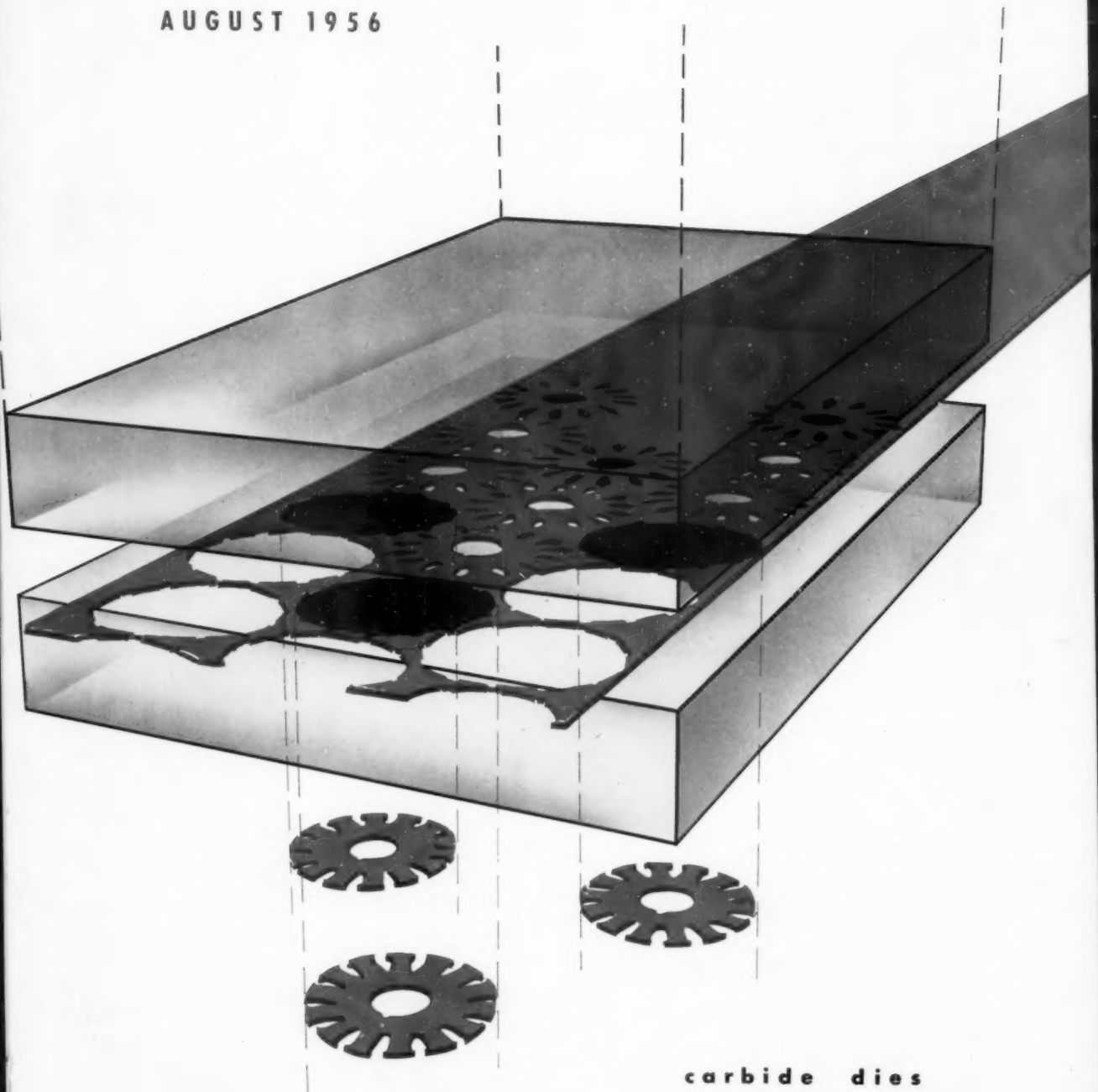


THE

Tool Engineer

AUGUST 1956

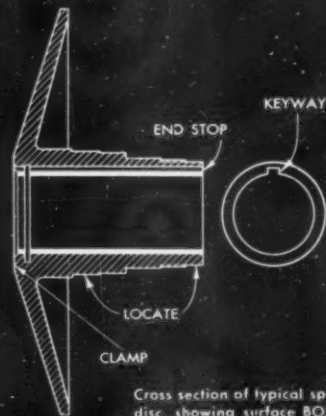
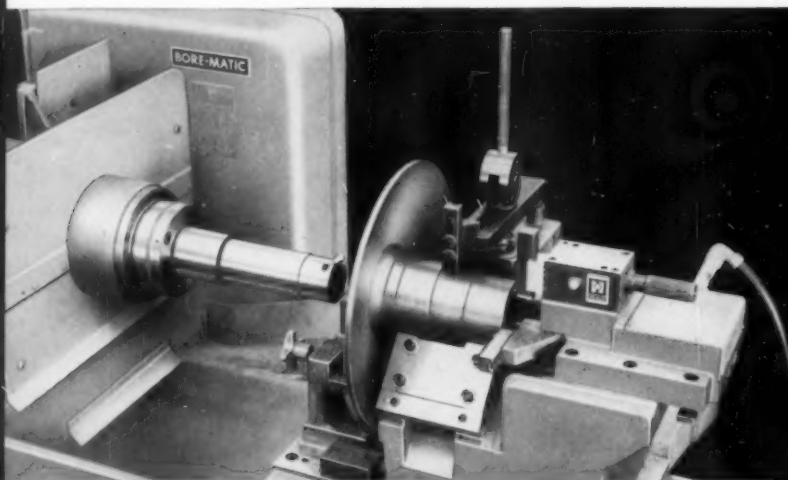


carbide dies

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

The extreme versatility
of Heald **BORIZING***
permits faster precision
finishing of both long-run
jobs and small-lot work
with frequent changeovers

FOR EXAMPLE: *This One Bore-Matic Finishes 41 Different Parts,
with a production increase of over 200%!*



The Model 221 Bore-Matic shown above is equipped with interchangeable tooling and adjustable fixture for precision boring 41 different speed changer discs, with bore diameters ranging from 0.688" to 3.2510" and bore lengths from 2 $\frac{3}{8}$ " to 9 $\frac{3}{8}$ ". Compared to the previous method of doing the same job, BORIZING increased total net production from 4 parts to 13 parts per hour.

It PAYS to come to Heald

*BORIZING is a copyrighted word meaning the application of any number or variety of precision finishing operations performed on a Heald Bore-Matic.



THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

COVER: Improved tooling and increased service life have always reduced production costs. With mechanization, tool reliability and life have achieved added importance. Starting on Page 78 is an article describing construction of money-saving carbide lamination dies.



The Tool Engineer

Volume XXXVII, No. 2

August 1956

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THE TOOL ENGINEER is regularly indexed in the
Engineering Index Service and the Industrial Arts Index

PLANNING · ENGINEERING · CONTROL · TOOLING · EQUIPMENT · PRODUCTION

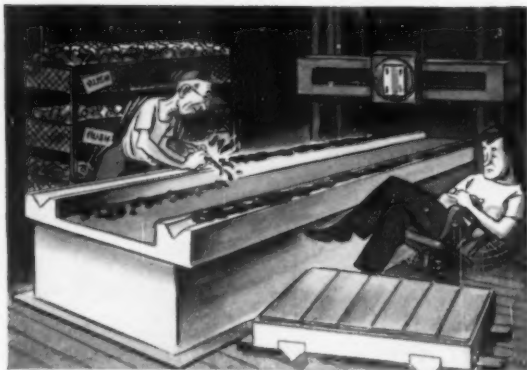


1. Cures "stick-slip" or "jumpy table". When a table gets the "shakes", especially after it has just reversed or when the load is heavy and the speed slow, it's probably suffering from "stick-slip". Remedy—Sunoco Way Lubricant®. Special polar compounds in Sunoco Way Lubricant form a friction-reducing film that keeps a table sliding smoothly under all operating conditions.



2. Doesn't squeeze out. When you use a heavy oil as a way lubricant, you must use a lot of oil to maintain a thick enough film. But, heavy oil squeezes out if the table sits in one position very long. You have a tough time getting the table moving again. Protected by the tenacious thin film formed by Sunoco Way Lubricant, the machine can be idle for a week and it will start easily.

WHY SUNOCO WAY LUBRICANT CAN HELP CURE YOUR MACHINING PROBLEMS



3. Protects expensive ways. Badly scored or pitted ways, caused by inadequate way lubrication, result in lost production and expensive repairs. The high film strength of Sunoco Way Lubricant eliminates the danger of metal-to-metal contact, the chief cause of scoring and way wear. Excellent metal-wetting and non-corrosive properties eliminate rusting and pitting.



4. Approved by more than 55 machine-tool builders. Every major machine-tool builder has tested Sunoco Way Lubricant. It is always approved. In fact, to assure maximum efficiency of their product, many manufacturers ship a supply of Sunoco Way Lubricant with each machine. We'll be glad to send you the list of manufacturers who have approved Sunoco Way Lubricant.

For more information, see your Sun Representative, or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. TE-8.

INDUSTRIAL PRODUCTS DEPARTMENT
SUN OIL COMPANY
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The Tool Engineer

Engineering and Ingenuity

Given sufficient information and an adequate budget, any engineer familiar with production methods can select new equipment to do a particular job. It takes ingenuity, however, to economically fit the job to existing machines. This is tool engineering of high order.

Many plants cannot afford extensive retooling and remain competitive. The tool engineer must use equipment already available to him. Retooling a machine properly involves a thorough understanding of its capacity and ability so that parts can be produced economically within the tolerances necessary. For medium or small-lot sizes, tooling costs are necessarily relatively high. Yet the tooling cannot be a Rube Goldberg. It must function adequately and simply with minimum maintenance. Down time and maintenance can easily turn a profit into a loss.

Simplicity is a virtue. Its benefits apply equally to product and methods of manufacture. Often, in adapting existing equipment, it becomes necessary to recommend redesign of parts. To make proper recommendations involves understanding of the design and function of the product. The same brand of ingenuity and resourcefulness can fit the product and process together into a mutual bond to the benefit of all.

Selection of additional machines and equipment should be preceded by real soul searching to assure that the newly acquired equipment will be useful for more than the specific job that occasioned its purchase.

John W. Greve

EDITOR



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The **ONE** truly **ALL-PURPOSE** Dial Gage

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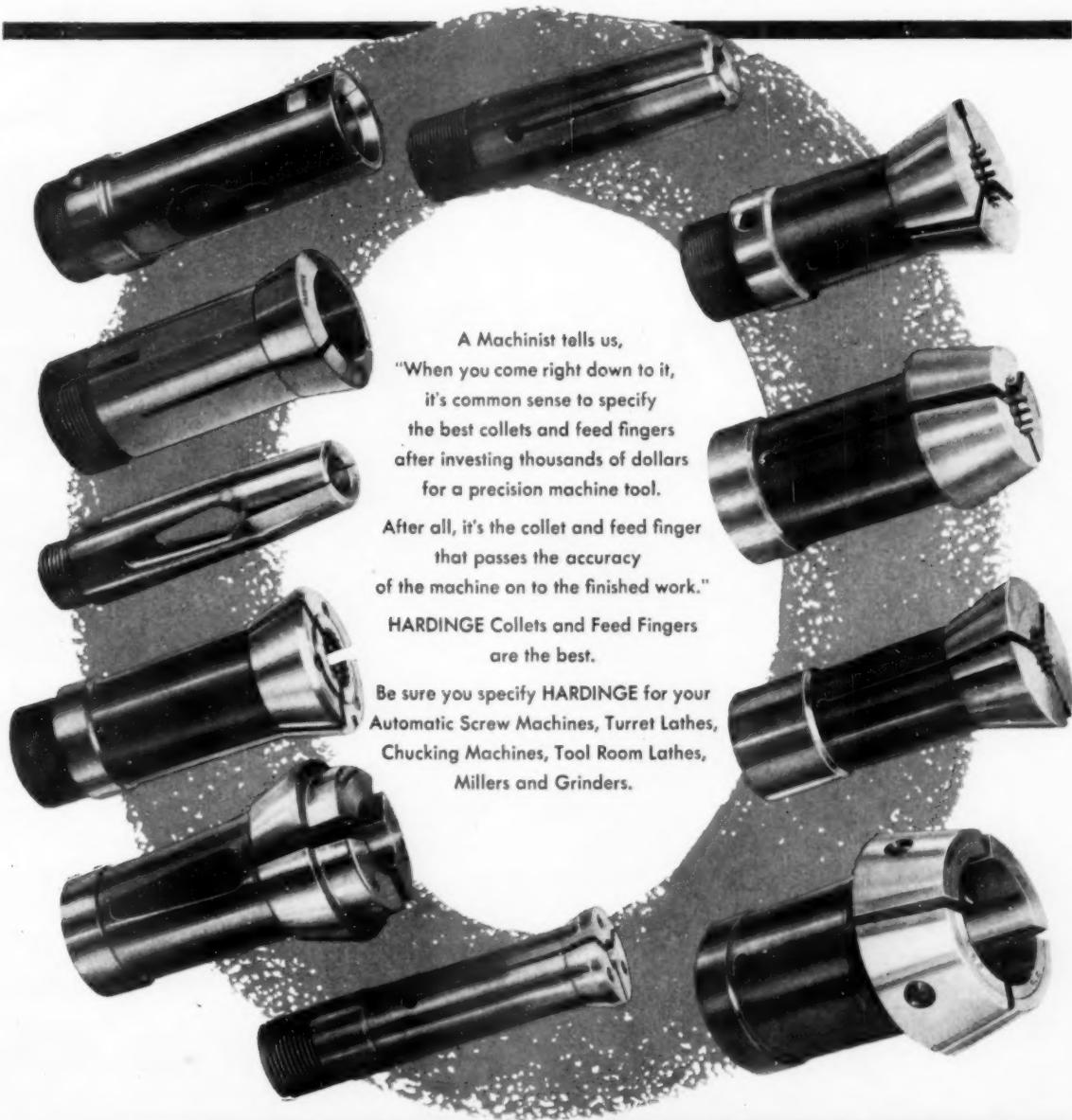
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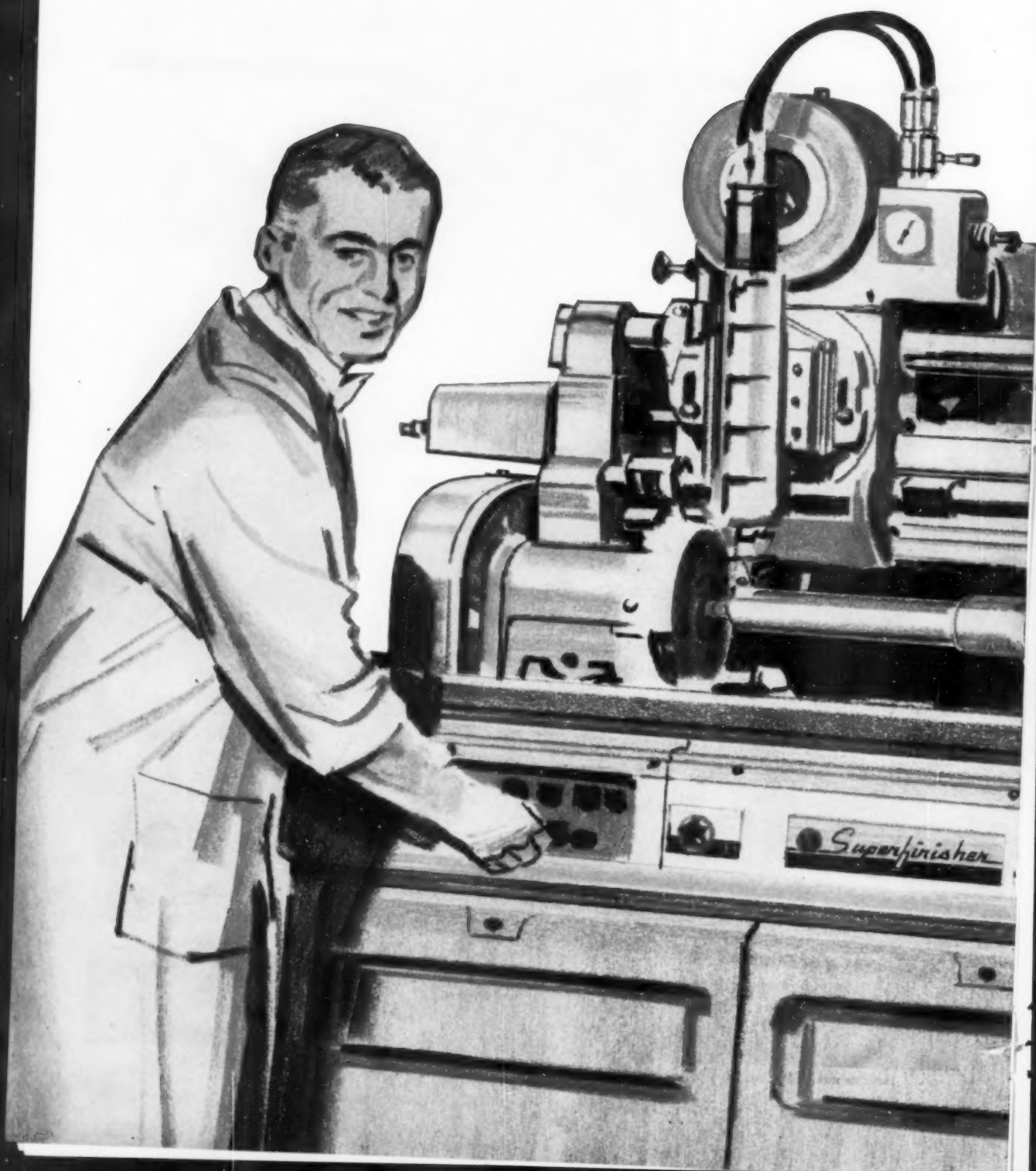
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Immediate stock delivery from Elmira, Dayton, Chicago, Minneapolis, St. Louis, Detroit, San Francisco, Los Angeles, Philadelphia, Hartford, New York.

August 1956

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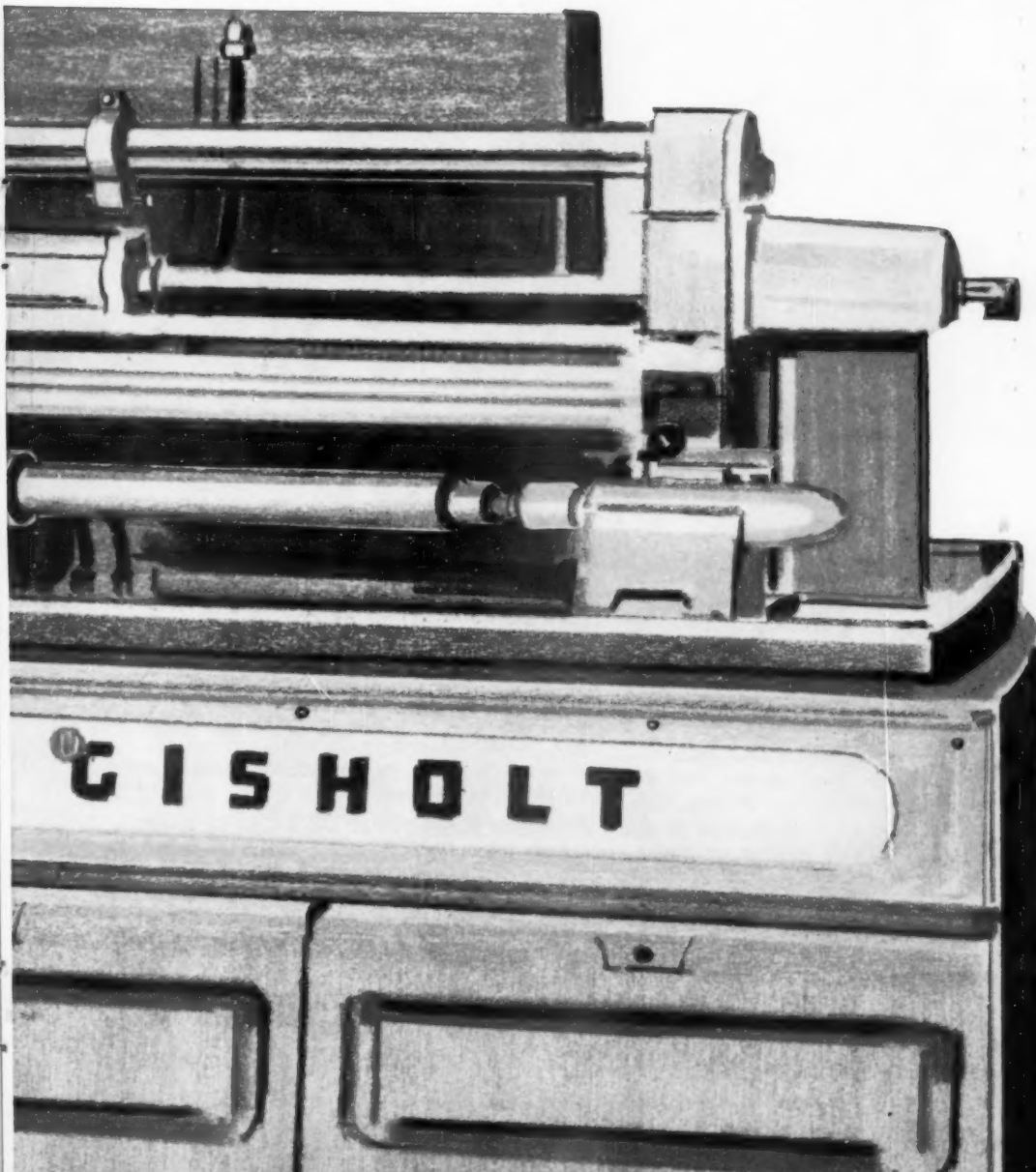


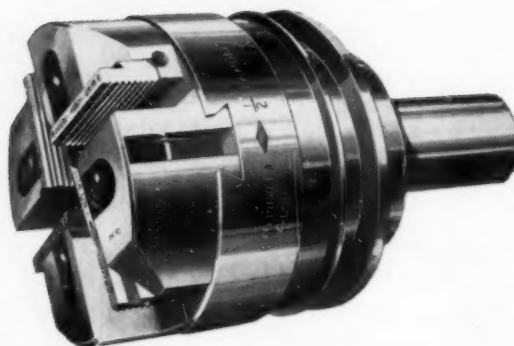
GISHOLT MASTERLINE 52A SUPERFINISHER



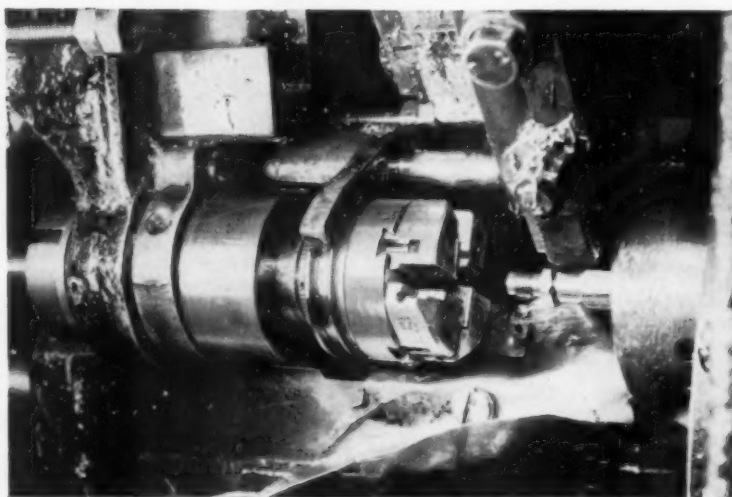
The Superfinishing process is recognized as one of the most important contributions to modern metalworking. Now—in this new 52A MASTERLINE Superfinisher—Gisholt offers an outstanding machine for either small job-lot work or high production runs. Other general purpose and high production models complete the line. Let us give you the complete facts on how Superfinishing may be profitably applied to your manufacturing processes—plus full details on the complete line of Gisholt Superfinishing Machines.

Gisholt Machine Company, Madison 10, Wisconsin
Look ahead—keep ahead—with Gisholt





Economy Threading On Limited Clearance Automatics



To assure economy threading on automatic screw machines where limited die head clearance is a major factor Frank H. Wilson Co., Inc. in Detroit, Michigan use the $\frac{1}{2}$ " LL LANDEX Head. Applied to one of their small Acme-Gridley's for threading tubing nuts this head cuts $\frac{1}{4}$ ", 20 pitch UN threads $\frac{3}{4}$ " in length on B1113 screw stock to a class three fit. An average of 20,000 pieces are threaded between chaser grinds.

Compactly designed with only a $2\frac{1}{16}$ " swing the $\frac{1}{2}$ " LANDEX will thread all diameters from #4 to $\frac{1}{2}$ ". A minimum number of working parts made of hardened and ground alloy steel, chaser holders designed to eliminate warpage and springing, and the use of precision LANDIS Tangent Chasers . . . all contribute to the high degree of rigidity and accuracy of this LANDEX Head.

Compare the chaser lengths in the illustrations and note the long life this LANDIS User has received from the chasers used in this application. These chasers will still produce thousands of threads as (1) LANDIS Tangential Chasers are usable for 80% of their original length; (2) only a few thousandths of metal need be removed from a chaser when regrinding; (3) when regrinding the same amount of metal need not be removed from each chaser; (4) long chaser life is received between grinds. These are the basis for economy in any threading operation.

For further information on this LANDEX Head and on other LANDIS Heads using Tangential Chasers and designed for all types of thread-cutting operations write for Bulletins F-80 and F-90. Please send specifications when writing.

LANDIS Machine Company

396

WAYNESBORO • PENNSYLVANIA • U. S. A.

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NEW



Rugged — shockproof — withstands more impact. Improved life under all conditions. All gears, racks, and pinions precision hardened — friction reduced 16% to 25%, depending upon magnification . . . a new high in sensitivity. Calibrated accuracy greatly improved. Off-white dials and fine line graduations facilitate readings. Available in four sizes. Enthusiastically received in shop tests.

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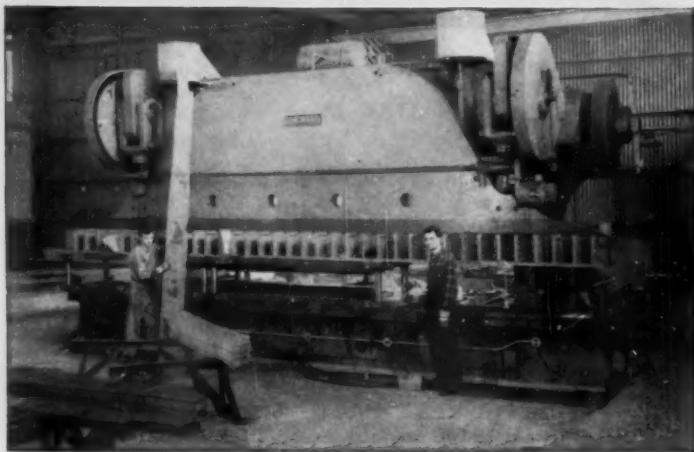
70 minutes cut

on combined blanking and punching operations!

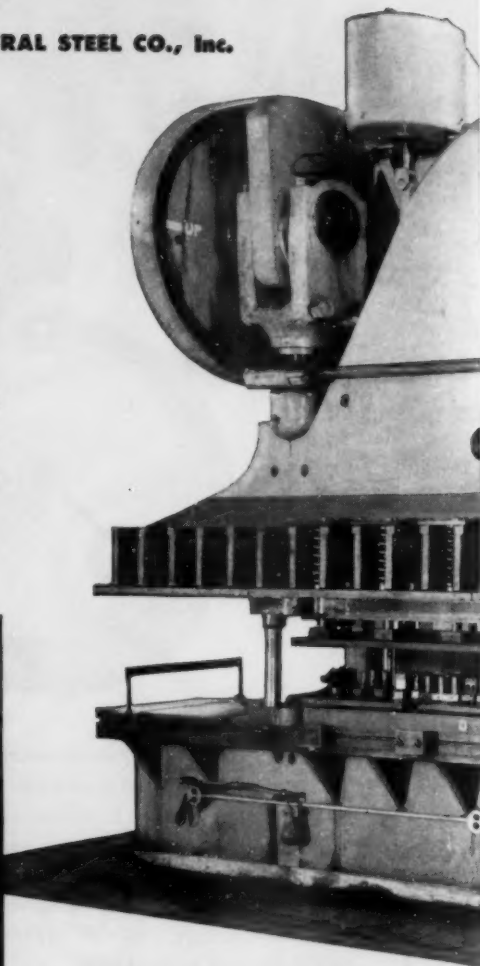
— FORT WAYNE STRUCTURAL STEEL CO., Inc.
Fort Wayne, Ind.

This versatile Cincinnati All-Steel Press Brake, 34 Series x 16', has revolutionized the production of these long motor truck side rail reinforcements.

Check with our die engineering department on the application of a versatile Cincinnati All-Steel Press Brake in your shop. It can sharply reduce your production costs.



(A) Blanking floor to floor time $1\frac{1}{4}$ minutes.
Previous time 34 minutes.



(B) Note Fort Wayne's ingenious punching equipment which reduced punching time from 36 minutes to $1\frac{1}{4}$ minutes and took advantage of every versatile Cincinnati feature.

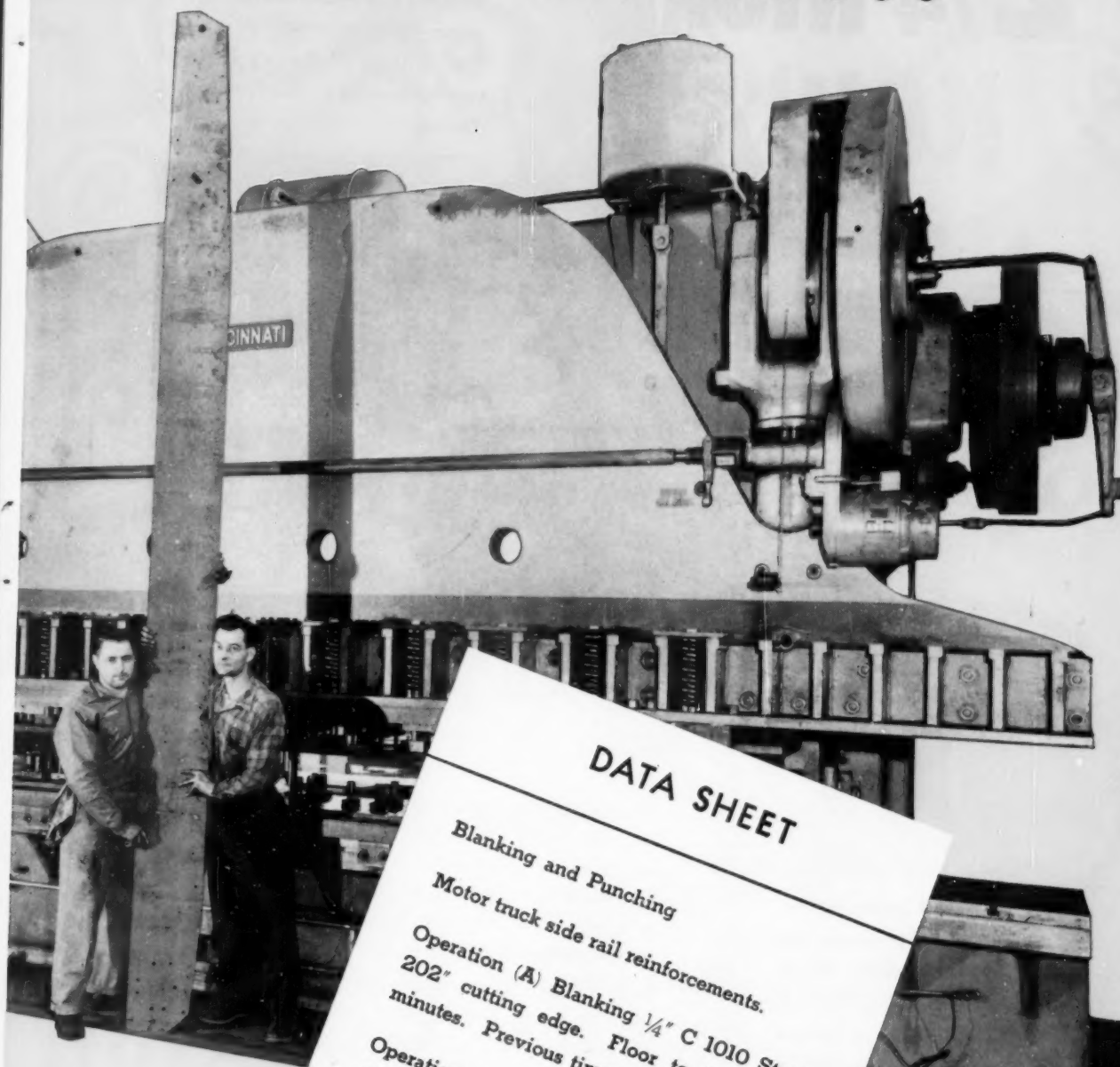


THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A.

SHAPERS • SHEARS • BRAKES

to 2.6 minutes...



DATA SHEET

Blanking and Punching
Motor truck side rail reinforcements.

Operation (A) Blanking $\frac{1}{4}$ " C 1010 Steel
202" cutting edge. Floor to floor— $1\frac{1}{4}$
minutes. Previous time—34 minutes.

Operation (B) Punching 130 holes per
stroke. Floor to floor— $1\frac{1}{3}$ minutes. Previ-
ous time—36 minutes.

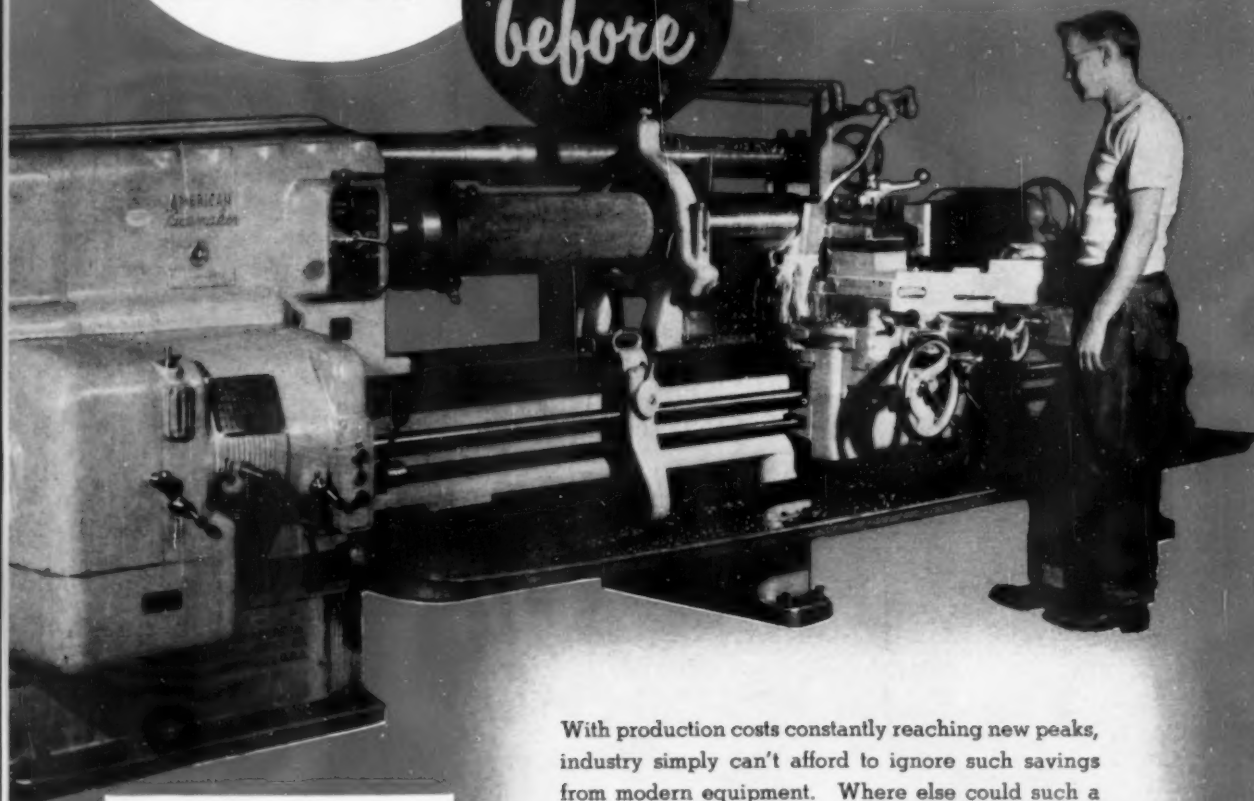
John L. Hayner
President

Photos Courtesy—
**FORT WAYNE
STRUCTURAL STEEL CO., Inc.**
Fort Wayne, Indiana

2¼ hrs. now

9 hrs. before

Fairbanks, Morse & Co.,
Beloit, Wisconsin, is really
putting the payroll dollar to
work with its new 20 inch
"AMERICAN" Heavy Duty
All-Hydraulic Duplicating
Lathe.



**2000 horse power
Fairbanks-Morse motor
shafts are now being
rough and finished
turned in 2¼ hours
floor to floor against a
former time of 9 hours
per shaft.**

With production costs constantly reaching new peaks, industry simply can't afford to ignore such savings from modern equipment. Where else could such a magnificent return upon an investment be secured, and how else can costs be lowered to meet an increasingly competitive market?

More production per man hour is the answer and the only answer to prohibitive costs—modern, high production machinery is the answer to greater production per man hour.

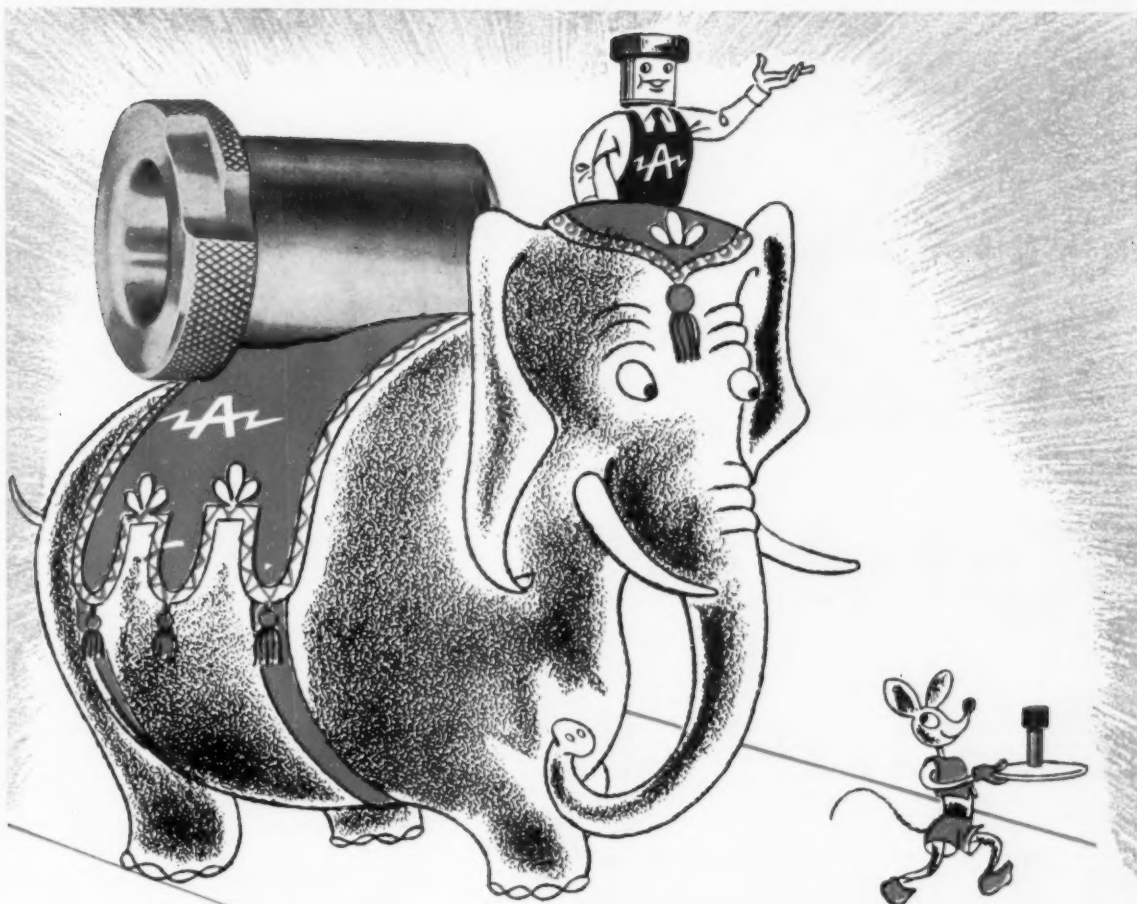
Put your payroll dollar to work for greater profits with "AMERICAN".

Bulletin No. 35 shows many examples—it's yours for the asking.

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Cincinnati 2, Ohio, U. S. A.

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**THERE'S NO LARGER RANGE OF STANDARD
BUSHING SIZES THAN**

American's!

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A WIDER RANGE OF A. S. A. AND AMERICAN
STANDARDS IMMEDIATELY AVAILABLE TO YOU.

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specify American. There's an exclusive American Distributor near you.



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LOS ANGELES 58, CALIFORNIA

FROM THE SMALLEST TO THE LARGEST, THE RIGHT DRILL BUSHING IS AN AMERICAN DRILL BUSHING

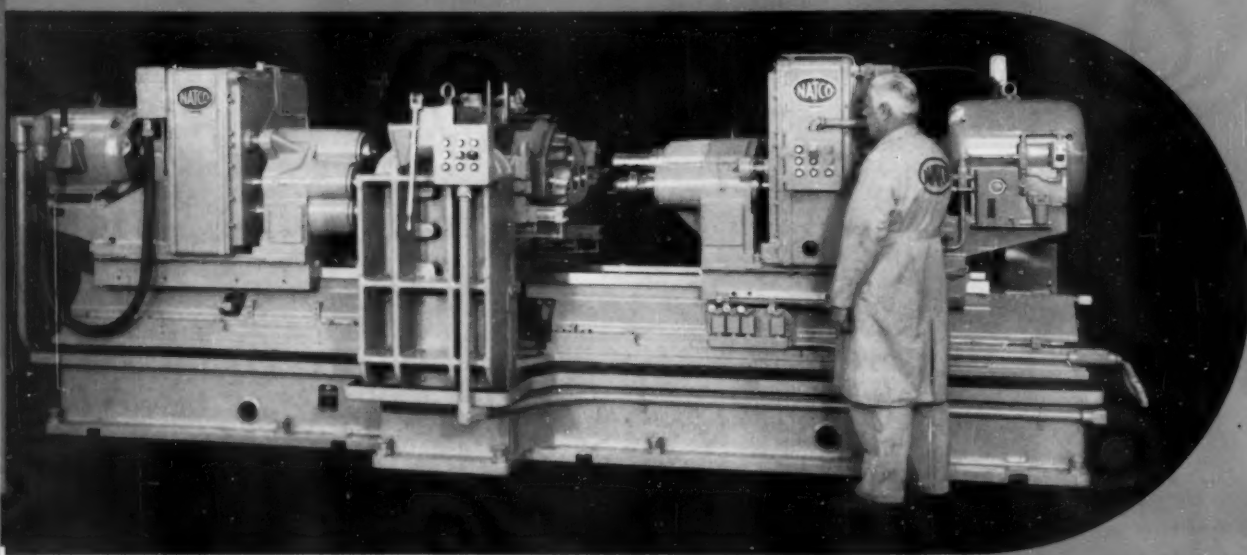
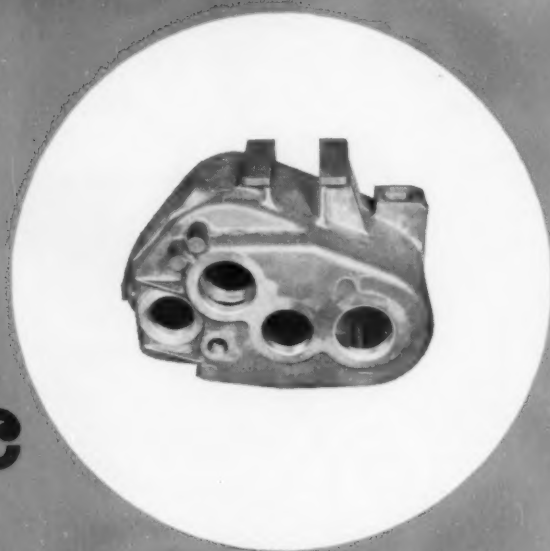
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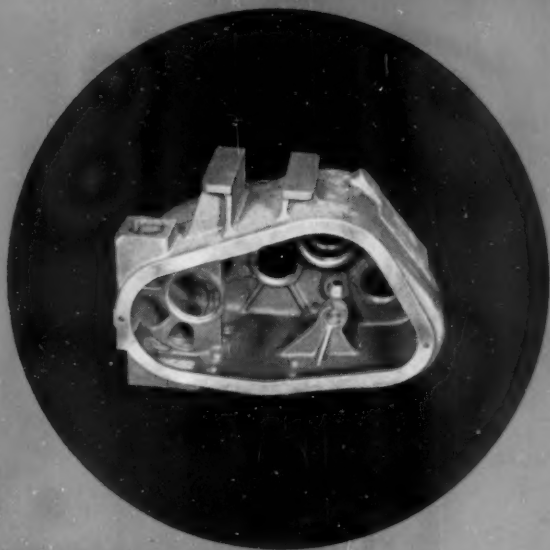
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Natco[®] **Automatic** **Matches** **Boring Mill** **Accuracy**

and quickly converts for five different jobs





This Natco two-way machine stepped in where automatics "fear to tread!" It replaced a precision boring mill, speeded production and didn't give up a tenth in accuracy! At The Frank G. Hough Co. boring mills were used for exacting tolerances on transmission parts for the Hough Payloader®. Higher production was desired.

Now with a Natco two-way automatic, Hough is getting production rates—not job shop rates. The Natco bores diameters to within .0005"—square with mounting face within .0005" per inch bore length. The machine also chamfers, counterbores and notches boss contours.

Versatile too! Hough processes five different transmission housings or covers with a single machine. After a typical production run averaging 100 parts, the machine is quickly converted to another job.

Ask for information about the PAYD (Pay-As-You-Depreciate) Finance Plan.

National Automatic Tool Company, Inc. *Richmond, Indiana*

Multiple-spindle drilling, boring, facing and tapping machines. Special machines for automatic production.

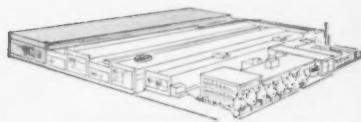
Call Natco offices in Chicago, Detroit, Buffalo, New York, Boston, Philadelphia, Cleveland and Los Angeles; distributors in other cities.



Notes from Natco...

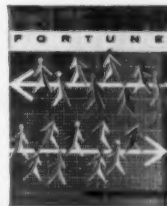
Middle Age Spread

Having reached the age of 55 feeling as spry as the day we started, we at Natco are going to spread out. The demand for our products makes this necessary since we're anxious to give our customers the kind of deliveries they need.



After Jan. 1, 1957, when the job is finished, we'll have eight acres under one roof at our Richmond, Indiana plant. We figure it will increase our production capacity about 50%.

To take care of the increased need for Sales Service, we've already increased our staff about 50% and provided them with new efficient quarters.



Appreciating Depreciation

Depreciation, we've come to realize, is one of the least understood and most important aspects of the business picture today. Though we're far from experts on the ins and outs of this complex subject, we've undertaken to discuss the importance of looking at depreciation realistically in our current FORTUNE campaign. We'll be happy to send you reprints if you'll drop us a line.

Guarantee **TOP** Performance and Maximum Life!

Specify **THESE TOP QUALITY FEATURES...**

(Standard on Miller Cylinders at no extra cost)

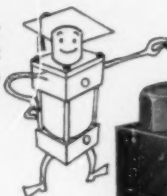
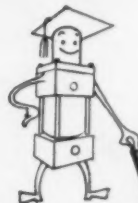
Specify **CASE HARDENED CHROME PLATED PISTON RODS**

On all Air and Hydraulic Cylinders

Benefits To You

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences. Available from Miller at no extra cost.

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust. Available from Miller at no extra cost.

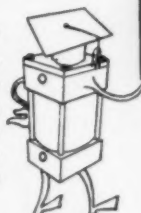


Specify **"TEFLON" WIPERS**

On all Air and Hydraulic Cylinders

Benefits To You

"TEFLON" Rod Wipers and "TEFLON" Hydraulic Piston Rod Seals withstand temperatures from -100°F. to plus 500°F. They are impervious to practically all known chemicals, including the fire-resistant, special, and standard hydraulic fluids in current use. Available from Miller at no extra cost.



Specify **TEFLON HYDRAULIC ROD SEALS**

On all Hydraulic Cylinders

Benefits To You

Highest quality Black Ferric Oxide Finish provides rust protection in air cylinder operation and on all cylinders during shipping and installation.

Cylinder heads, caps, mountings, pistons, followers, tie rods, and the unplated portions of the piston rods have this finish at no extra cost on all Miller cylinders. (This finish not recommended for water service)



Specify **RUST RESISTANT SURFACES**

On all Air and Hydraulic Cylinders

You may wish to route this entire page to the proper department in your company, by using this handy form. Additional copies on request. →

To (Dept.) _____
"On all our future cylinder requirements, please specify the above quality features."

Signed _____

Title _____

NOTE. On all Miller Hydraulic Piston Seals: Leather Cup Seals are *standard*, Piston Ring Seals are optional at *no extra cost*, and "Teflon" Cup Seals are available at *extra cost*.

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FLICK-REEDY CORP.

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Melrose Park, Ill.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

How Jessop skill makes better saw steel



If you could peer down into the Jessop mill, chances are you'd see groups of men hand-rolling sheets of steel with a degree of skill and careful concentration that might seem excessive at first glance. *Yet it isn't.* These men are producing a very special steel—top quality high-speed sheet which is used in the making of hack-saw blades, wood-working tools, metal-slitting saws, general industrial knives, and the like. But *skillful finish rolling isn't all.* Jessop rigidly controls its melting formulas and pours small ingots specially designed for cross rolling. This insures a fine uniform grain structure so that the stock blanks well, forms well, swages well and has superior edge holding qualities. Remember, when you order your saw steel from Jessop, you are buying the finest that Jessop experience can offer. *And that's mighty fine steel.*

JESSOP

STEEL COMPANY • WASHINGTON, PENNSYLVANIA

OFFICES IN PRINCIPAL CITIES

Jessop Steel of Canada Limited, Wallaceburg, Toronto

Jessop Steel International Corp., Chrysler Building, New York, New York



ACTION PICTURE **of how to save money** **by riveting!**

This action photo, taken on the frame assembly line in one of the largest auto factories, illustrates how cost-conscious manufacturers save money with Hannifin "Hy-Power" Hydraulic Riveters.

First step in assembly is to rivet the frame together...with Hannifin "Hy-Power" Riveters. The light-weight forged C-Frames hang from balancers within easy reach of each operator. No special skill is required to head the $\frac{3}{8}$ " rivets, cold, each in seconds. What's more, this "silent squeeze" method forms stronger, more uniform rivets, hot or cold.

Power source is the Hannifin "Hy-Power" Hydraulic Pressure Generator which quietly supplies pressure to the "Hy-Power" Cylinder that does the work. These riveters are available in 7½, 10, 12½, 17½, 25, 35, 50, 75 and 100-ton capacities.

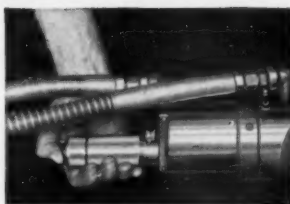
do ALL you can do...with

HANNIFIN

Hannifin Corporation, 519 S. Kilbourn Ave., Chicago 24, Ill.

Air and Hydraulic Cylinders • Hydraulic Presses • Pneumatic Presses • "Hy-Power" Hydraulics • Air Control Valves

here's the **HANNIFIN** **"HY-POWER"** **WORK CYCLE**



In position. A single control button starts (or interrupts) the automatic Hy-Power cycle.



Ram approaches fast, then hydraulic pressure automatically intensifies, and the rivet head is formed.

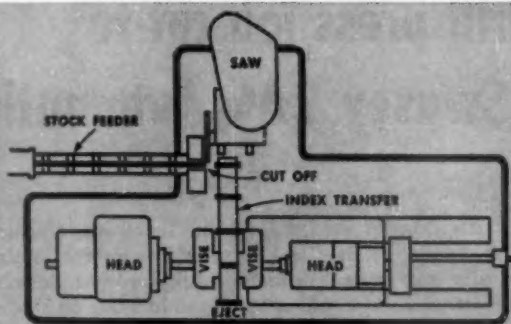


Fast, automatic return. Total elapsed time to head a rivet is only 2 to 3 seconds.

"HY-POWER" CAN ALSO **BE USED IN MULTIPLE** **TO SET SEVERAL RIVETS**

Bulletin 150 tells how to save money on riveting, staking, punching, forming and bending operations. Write for copy.

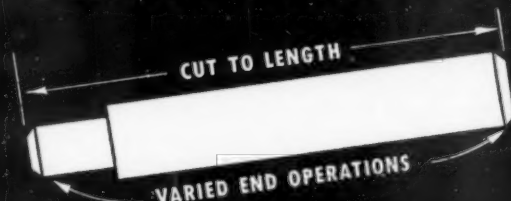




HOT BED OF ACTIVITY

Motch & Merryweather's new transfer machine widens the horizon for the simultaneous double-end machining of bar stock or tubing. Combined with cut-off to accurate length are: centering, chamfering, turning, drilling, or boring. Box mill turning is performed along with center drilling and chamfering. From stock pile to discharge, all operations can be fully automated. For the quickest answer to speed your stock processing, send us your part drawing.

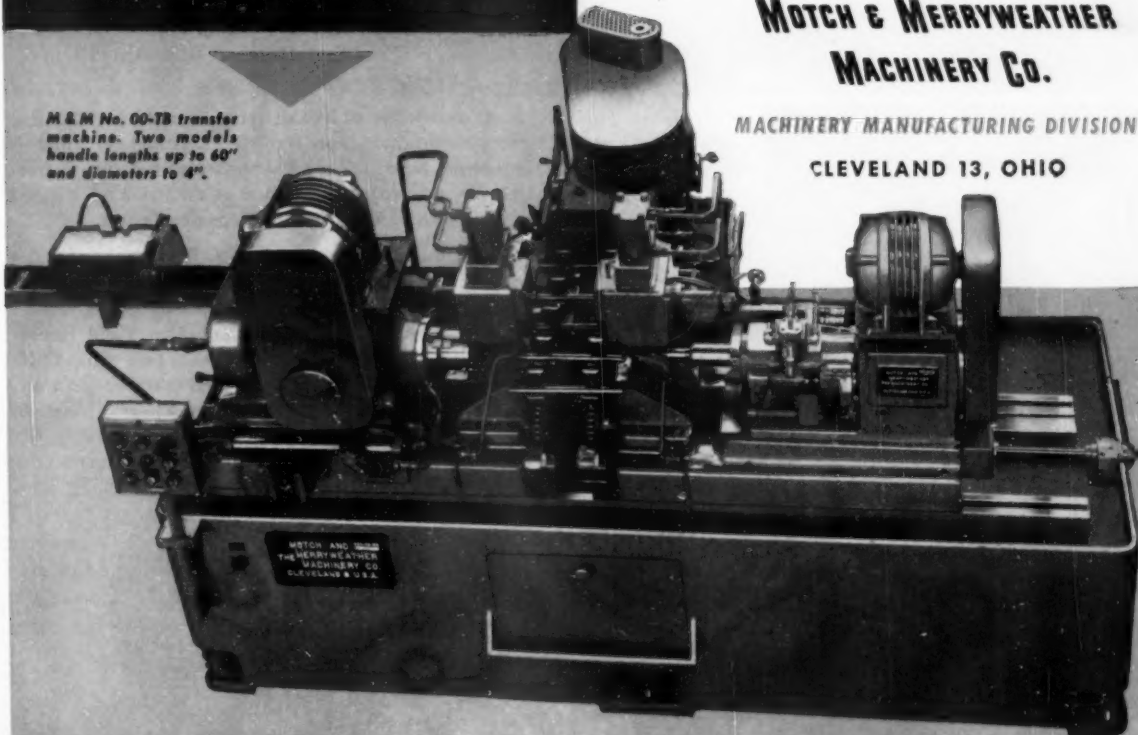
Simultaneous STOCK CUT OFF and DOUBLE END MACHINING



M & M No. 00-TB transfer machine. Two models handle lengths up to 60" and diameters to 4".

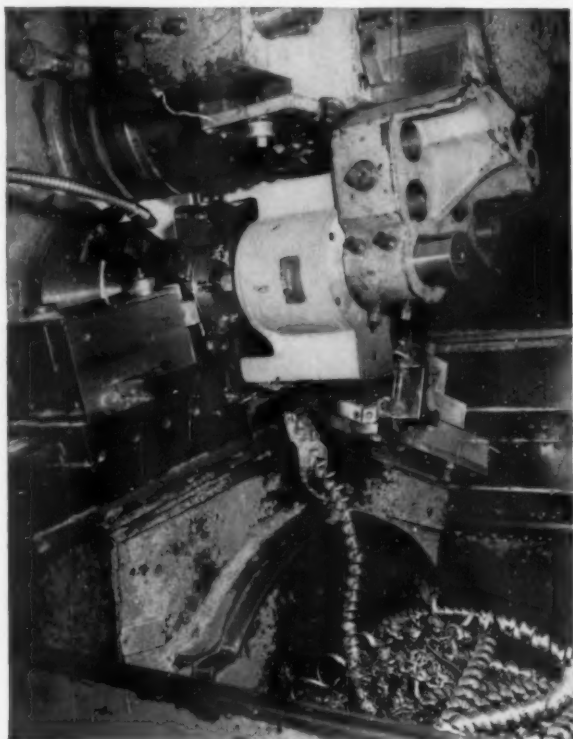
THE MOTCH & MERRYWEATHER MACHINERY CO.

MACHINERY MANUFACTURING DIVISION
CLEVELAND 13, OHIO



BUILDERS OF AUTOMATIC PRECISION CUT-OFF, MILLING, AND SPECIAL MACHINERY

12-minute lathe and drill press job cut to 2¾ minutes on Warner & Swasey 2AC Automatic



OTM CORPORATION, Houston, Texas, manufactures a variety of sizes and types of flanges for joining pipe such as used in the oil and chemical industries. Machining operations have been handled on a number of turret lathes and drill presses until recently, when five sizes of flanges were transferred to a new Warner & Swasey 2AC Automatic Chucking Machine.

Previous job time on a 1½" 150-pound lap joint flange was 12 minutes, and required two operations—machining the face and drilling four holes on the bolt circle. Now the entire job is done in one operation on the 2 AC in 2¾ minutes!

The adaptability of this automatic to all kinds of work is demonstrated in the tooling required for this job. A multiple drill head for drilling the bolt holes is mounted on the pentagon turret. It is driven by an extension arm which shocklessly engages a dog on the face of the chuck, when the turret is traversed at a reduced rate toward the chuck. Once engaged, the speed and feed are raised to the proper rate for drilling.

Facing the flange requires that no withdrawal spirals are left, which would cause pressure leaks. This is accomplished on the 2 AC with a retractable facing block on the front cross slide which relieves the cutter on the return stroke.

A somewhat universal setup is used for the five flanges produced, so setup or changeover time is under an hour. It's merely a matter of setting cutters to size, and adjusting trip dogs on the 2 AC's speed and feed selector and cycle control drums.

Fast, automatic machining, flexibility, and the quick, easy setup of Warner & Swasey Single Spindle Automatics ideally suit these machines to many small lot, so-called "turret lathe" jobs. Our Field Representative can soon tell you whether you can handle jobs in your own plant faster, with extreme accuracy, and more profitably on these automatics. Call him in.



WARNER & SWASEY AUTOMATIC CHUCKING MACHINES

1 AC 8" or 10" Chuck
6" Working Stroke

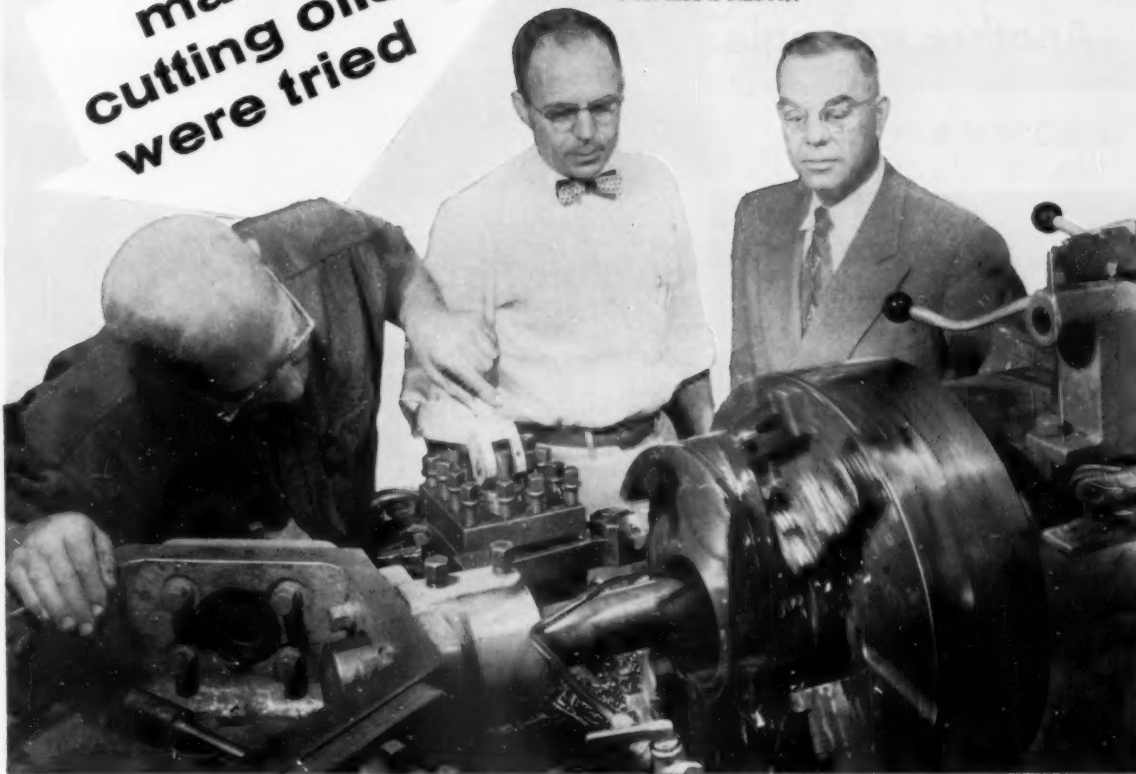
2 AC 10" or 12" Chuck
9" Working Stroke



YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

many
cutting oils
were tried

Mr. J. R. Weidenheimer (center), Plant Superintendent of the Lynch Corporation, and Mr. L. C. Williams (right), Gulf Sales Engineer, check the performance of Gulfcut 21 on an Acme Turret Lathe where a cam is being machined. Steel used is NE8445.



... GULFCUT 21 was chosen

by the Lynch Corporation, Anderson, Indiana

"We did not choose Gulfcut 21 at random," says Mr. J. R. Weidenheimer, Plant Superintendent of the Lynch Corporation, well-known glass machinery manufacturer. "Many different cutting oils were tried but Gulfcut 21 proved best in our tests. We feel that it gives better protection to the tool and contributes to a smoother machining operation."

Scores of machine shops have discovered, as the Lynch Corporation did, that Gulfcut 21 is the answer when the job calls for a sulfurized mineral type cutting oil.

One important reason for the outstanding performance of Gulfcut 21 is a special Gulf process

of combining sulfur. This provides greater sulfur activity over the entire range of a cutting operation—gives the tool maximum protection and helps to reduce built-up edge. Gulfcut 21 also has excellent anti-weld characteristics and extreme load carrying ability.

Gulfcut 21 is only one of the complete line of quality GULFCUT oils that will help you get improved production and longer tool life in all your machining operations.

Call in a Gulf Sales Engineer and have him recommend the most suitable type for each specific job in your shop. He is available through your nearest Gulf office. Consult your local directory



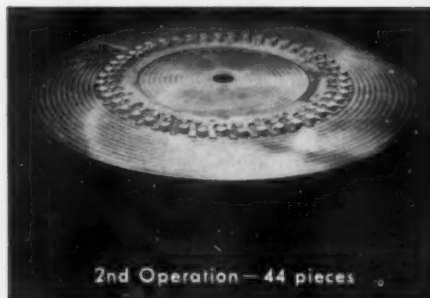
GULF OIL CORPORATION • GULF REFINING COMPANY
1822 Gulf Building, Pittsburgh 30, Pa.

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

Another example



W-1138



W-1139

of Blanchard versatility



No. 303 Stainless Steel Forging

653 oddly shaped, non-magnetic workpieces

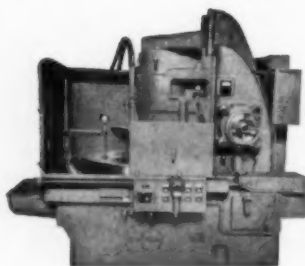
Blanchard Surface Grinders are noted for their unusual versatility—like grinding small, non-magnetic stainless steel forgings in quantity.

In the first operation, 653 forgings are loaded and blocked between rings on a No. 18 Blanchard, with 36" magnetic chuck (stock removal .010"). Parts, chuck and rings are sprayed with oil, and molten sulphur is poured around the parts to hold them. After grinding, the sulphur is easily stripped away.

This entire operation takes only 1½ hours—including preparation of the sulphur.

In the second operation, 44 pieces are set in a notched steel ring. Tilting the wheelhead and maintaining wheel pressure in one direction holds these non-magnetic pieces in the notches. Stock removal from this surface is .030", to tolerance of $\pm .003$. Each load takes eight minutes—floor-to-floor.

As a result of this ingenious workholding, each piece is ground on both sides in a fraction of a minute, at less than 98¢ abrasive cost for all 653! That's typical of the convenience and economy of grinding on a Blanchard—whether the parts are magnetic or non-magnetic!



Send for free copies of "Work Done on the Blanchard", 4th edition, and "The Art of Blanchard Surface Grinding", 3rd edition—recently revised.



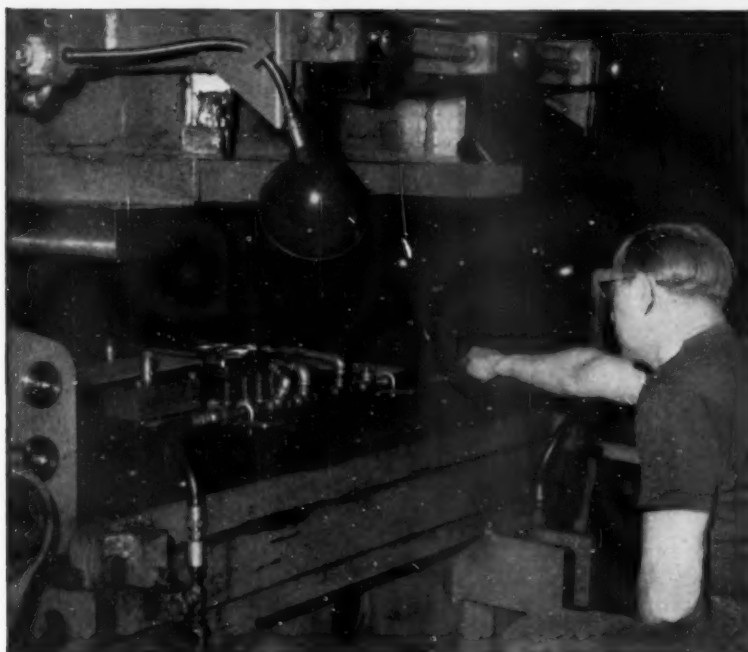
PUT IT ON THE **BLANCHARD**

THE BLANCHARD MACHINE COMPANY

64 STATE ST., CAMBRIDGE 39, MASS., U. S. A.



Tool Steel Topics



Maker of Washers Rings the Bell with Die Made of Lehigh H

A manufacturer of steel washers found that by using a piercing die made of Lehigh H tool steel, he could get longer, more economical production runs than with dies of another grade, formerly used.

The Lehigh H die produces thousands of round washers daily, in sizes from $\frac{5}{8}$ in. to 1 in. It is hardened to approximately Rockwell C 61, and pierces

5/32-in. C 1035 steel sheet. Because of the severity of the piercing operation, redressing of the die is required after every third turn, but only 0.020 in. is removed. Close to 100,000 washers are turned out between grinds.

Lehigh H handles this blanking job to perfection because of its outstanding wear-resistance and toughness. Lehigh H is a superb high-carbon, high-chromium grade of air-hardening tool steel. It can always be counted upon for a good job because of its resistance to wear, minimum distortion in heat-treatment, and high compressive strength.

TYPICAL ANALYSIS

Carbon 1.55	Molybdenum 0.80
Chromium 11.50	Vanadium 0.40

If there are applications in your shop which require a combination of wear- and shock-resistance, plus high compressive strength, look into the advantages of Lehigh H. Your local Bethlehem tool steel distributor, as friendly a man as you'll find anywhere, is at your service.



FILM "TEAMWORK" WINS AWARD AT COLUMBUS FESTIVAL



"Teamwork," our new 30-minute color film on tool steel, received an award for excellence in the Business and Industry category at the recent Fourth Annual Columbus Film Festival.

"Teamwork" takes you behind the scenes in describing typical applications of our carbon, oil- and air-hardening, shock-resisting, hot-work and high-speed tool steels. It is now available for showings to die-makers, heat-treaters, machinists, machine-tool manufacturers and distributors. It's also an excellent film for technical society meetings, and for student groups.

It's easy to arrange to see "Teamwork." All you need do is drop a line to the nearest Bethlehem office, or to Publications Department, Bethlehem Steel Company, Bethlehem, Pa. If possible, please select a showing date well in advance, to allow time for scheduling and shipping.

BETHLEHEM TOOL STEEL ENGINEER SAYS:



Punched Holes Often Close-in

In precision punching it is common practice to make the punch diameter exactly the same as that of the desired hole. (All the clearance required is then applied to the I.D. of the die.) For many operations involving holes greater than 1 in. diameter, for example, and stock less than $\frac{1}{4}$ in. thick, this procedure is correct. But in other operations it is incorrect, because the elasticity of the stock causes the holes to close-in after punching, so that the holes are actually smaller than the punch which made them.

With large-diameter holes and thin stock, the elastic springback which tends to close-in a punched hole causes the stock to buckle instead, so that the hole diameter will be accurate under these conditions. On holes 1 in. in diameter and smaller, expect a close-in of 0.002 to 0.003 in. with stock $\frac{1}{8}$ in. to $\frac{1}{4}$ in. thick, and a closing of 0.001 in. on stock 0.030 in. thick (22 gage). Closing will be negligible on stock 0.010 in. thick (32 gage) or less. For precision punching, therefore, add the expected close-in to the punch size to produce the correct hole diameter.

my name is

Ping
Ianitelli

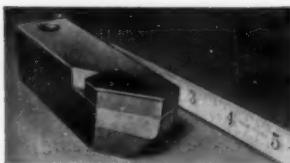
In charge
of our

"Prove It"

division
at elox

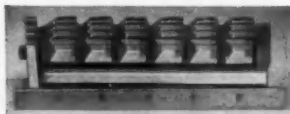


My division will actually machine parts for you. Not just a single sample, but enough production runs to provide a true evaluation of what Elox Electrical Discharge Machine tools can do in your plant. Tungsten Carbide tipped single point tools, forging dies, die casting dies and Tungsten Carbide form tools will be machined at a cost we guarantee impossible to duplicate except with Elox E.D.M. I've been able to prove to hundreds of alert concerns that these jobs can be done better, faster and less expensively with Elox than by any other method.



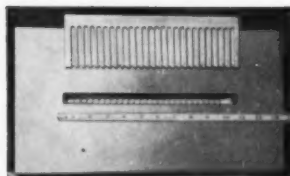
**WE SAVED
19 MINUTES**

grinding this single
point tungsten car-
bide tip boring tool.



**WE SAVED
16 HOURS**

plus 9 different
operations on this
form grinding of a
carbide broach.



**WE SAVED
379 HOURS**

on the machining of
this die casting die.

WHATEVER IT'S COSTING YOU NOW...CHECK WITH ELOX

elox *corporation of michigan*

1837 Stephenson Hwy.
Royal Oak 3, Mich.

*T.M. Reg.

THE **ULTIMATE**

IN

BEVEL
GEAR
ACCURACY



- low-cost tooling
- simplicity of set-up

NO. **120**
MIKRON

fine pitch
BEVEL GEAR
HOBGING MACHINE

RUSSELL, HOLBROOK & HENDERSON, INC.

292 Madison Avenue, New York 17, N. Y.

This

Cadillac

6" PLA-CHEK GAGE IS ACCURATE to .00005"



Cadillac
PLA-CHEK

For checking smaller jobs, gages, tools and dies, this portable 6" Cadillac PLA-CHEK Gage is accurate to .00005". It can easily be checked in and out of your tool crib to be used on the surface plate or at the machine. It is completely self-contained and extremely simple in operation. Speeds inspections from minutes to seconds.

Capacity of the 6" PLA-CHEK model can be increased by the addition of a 6" riser without affecting accuracy or sacrificing portability. Send coupon TODAY for complete details!

MAIL THIS COUPON FOR COMPLETE DATA

CADILLAC GAGE COMPANY

P. O. BOX 3806, DETROIT 5, MICHIGAN

Without obligation please rush complete information on the Cadillac PLA-CHEK Gage line to:

Name

Company

Address

City Zone State

Cadillac
GAGE COMPANY
P.O. BOX 3806 • DETROIT 5, MICH.

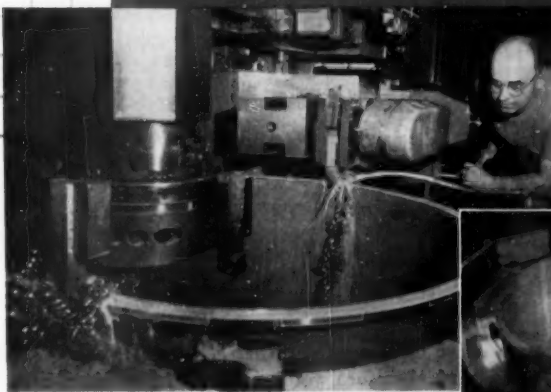
PRODUCTION "at all time Peak"

Solar Aircraft Company of Des Moines, Iowa and San Diego, California, has found the versatility and flexibility of the Bullard Man-Au-Trol V.T.L., Model 75 a distinct advantage in the machining and fabricating of various jet aircraft engine parts and assemblies.

with

BULLARD

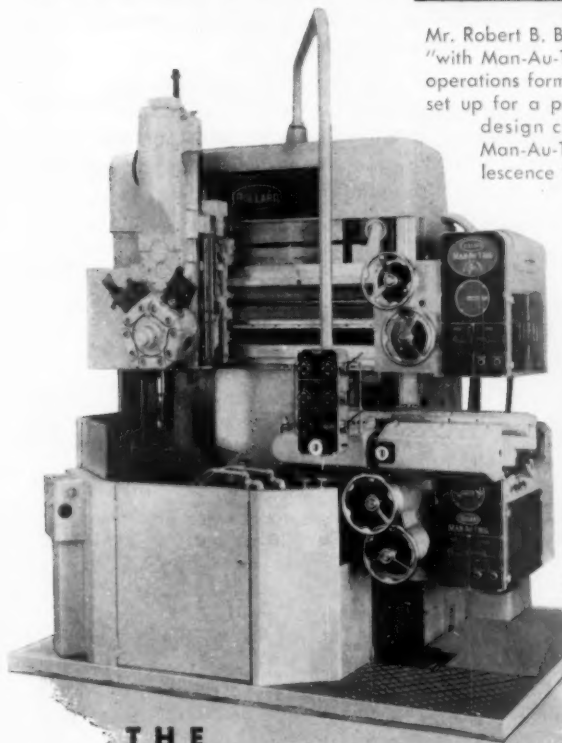
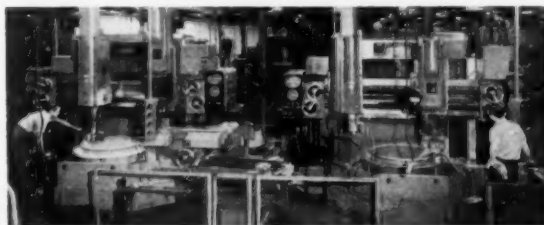
MAN-AU-TROL VERTICAL TURRET LATHE MODEL 75



Mr. Robert B. Ballard, Production Manager at Solar-Des Moines, reports that "with Man-Au-Trol, Model 75, it is possible to do a multitude of machining operations formerly requiring numerous expensive machines which had to be set up for a particular operation, so limited in scope, that an engineering design change either obsoleted the tooling or the machine. With Man-Au-Trol, Model 75, because of its wide range of functions, this obsolescence is greatly reduced — if there is a design change, only a new set-up is made — not the purchase of a new multi-thousand dollar piece of machinery."

These same advantages can be applied to your manufacturing methods —

Ask your Bullard Sales Engineer for complete details.



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BULLARD COMPANY
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CONNECTICUT**

THE BULLARD COMPANY

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Please send me a copy of the
NEW MAN-AU-TROL V.T.L., MODEL 75 CATALOG

NAME.....
COMPANY..... POSITION.....
ADDRESS.....
CITY..... ZONE..... STATE.....

FOR STATIONARY GAS TURBINE



in machining...

WHAT'S YOUR SCRAP RATE ...3%? ...5%? ...10%?

LAPOINTE

the only scrap in **BROACHING** is the chips!

It may seem naive to remind you that *all the machining skill* is engineered right into the broach itself, and therefore you get *no rejects* when broaching by Lapointe! Lapointe Broaching is the *one way* to obtain repetitive accuracy to close tolerances, *at a high production rate*. (You can't get this with any other machining method.)

So if you want to reduce your scrap pile, we recommend that you think seriously of converting some of your operations to Lapointe Broaching. We can help you in this connection, because we are known as "Broaching Headquarters" — the oldest and largest company in the business! Another reassuring fact: We can take the responsibility for your complete broaching problem . . . we build the broaching machines, build the broaching fixtures, and make the broaches!

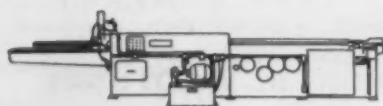
We'll answer your inquiry promptly.

THE LAPOINTE MACHINE TOOL COMPANY

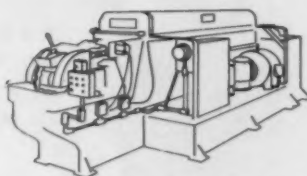
HUDSON, MASSACHUSETTS • U.S.A. In England: Watford, Hertfordshire

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

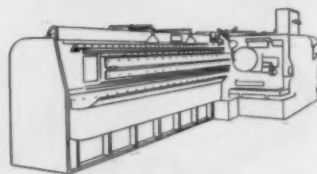
Here's a line of ELECTRO-MOTIVE DRIVE BROACHING MACHINES available only at LAPOINTE



60" STROKE HORIZONTAL, ELECTRIC



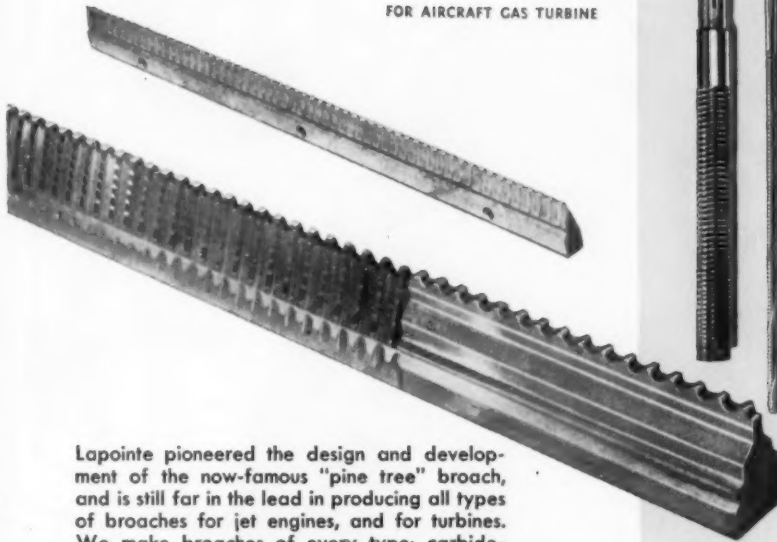
CH CONTINUOUS BROACHING, ELECTRIC



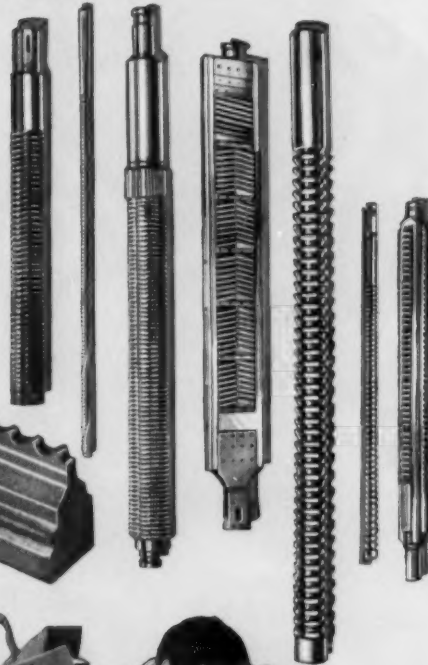
SRHE SINGLE RAM HORIZONTAL, ELECTRIC

Made from steel of our own specifications, and ground by expert operators to designs conceived by our capable broach-conscious engineers, it is only natural that LAPOINTE-made BROACHES are at the pinnacle of the broach-maker's art

FOR AIRCRAFT GAS TURBINE

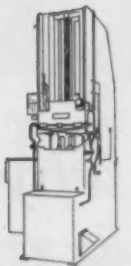


Lapointe pioneered the design and development of the now-famous "pine tree" broach, and is still far in the lead in producing all types of broaches for jet engines, and for turbines. We make broaches of every type: carbide-tooth, splines, rounds, flats, rectangular.

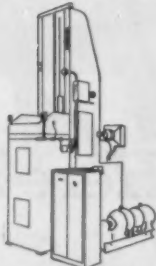


BROACH SHARPENER

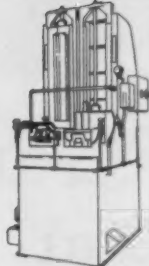
This efficient LAPOINTE machine for sharpening broaches is built in 3 sizes: 60", 72" and 80" capacity between centers. A different model, 36" size, is designed for sharpening small surface broaches. Literature available.



VUE-7 VERTICAL
PULL-UP ELECTRIC



SRVE SINGLE RAM
VERTICAL, ELECTRIC



DVE DOUBLE RAM
VERTICAL, ELECTRIC

LAPOINTE

known to be the best in
BROACHING

5



Here's why
"THE

The Tool Engineer

Men in 1

that's your **MFD***

He's a TAP man

He's a DRILL man

He's a CUTTER man

He's a REAMER man

He's a CARBIDE man

He's a Complete
tool man

*
your
**MORSE-
FRANCHISED
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MORSE TWIST DRILL & MACHINE COMPANY, NEW BEDFORD, MASS.

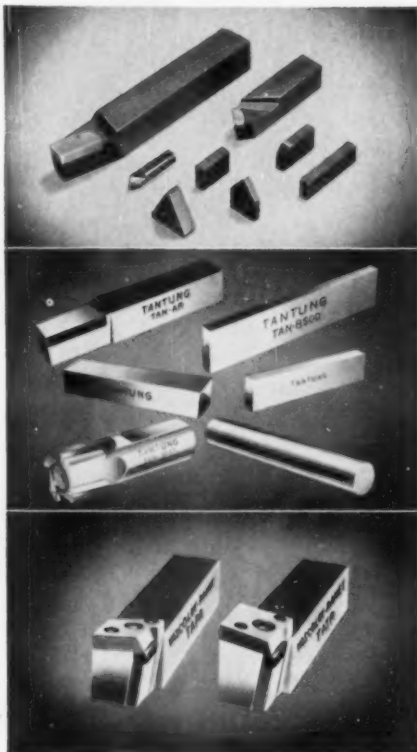
Subsidiary of VAN NORMAN INDUSTRIES, INC.

Warehouses in New York, Chicago, Detroit, Dallas, San Francisco • Buy tools by phone from your Morse-Franchised Distributor and save ordering time



MORSE means
MOST in Cutting Tools

How Multiple Tooling with Carbides and Tantung Cast Alloy Can Reduce Machining Costs



Surface Speed Dictates Choice of Tool

THE boring and turning operations on tool steel pictured at the right illustrate the economies possible by correct use of both carbide and cast alloy cutting tools.

To secure maximum production consistent with desired finish and tool life on the machine illustrated, the 8" O.D. is being turned at 450 surface feet per minute (215 RPM) with a V-R toolholder and throw-away carbide insert. This produces a boring speed of 112.6 SFPM on the 2" I.D. At this lower speed carbide tool life is drastically reduced by build-up, while H.S. steel tools fail prematurely because of excessive heat.

As can be seen from the Tool Selector Chart below, the answer is to use V-R Tantung cast alloy for the boring operation. The 112.6 SFPM is well within its cutting range. At this speed Tantung tool life is markedly superior to carbide or high speed steel. The reduction in regrinds and downtime results in higher production and major cost reduction.

Vascoley-Ramet manufactures a complete line of both carbide and Tantung cutting tools to provide maximum machining economy on any job. For complete details, call your V-R Representative or Distributor or write to V-R today.

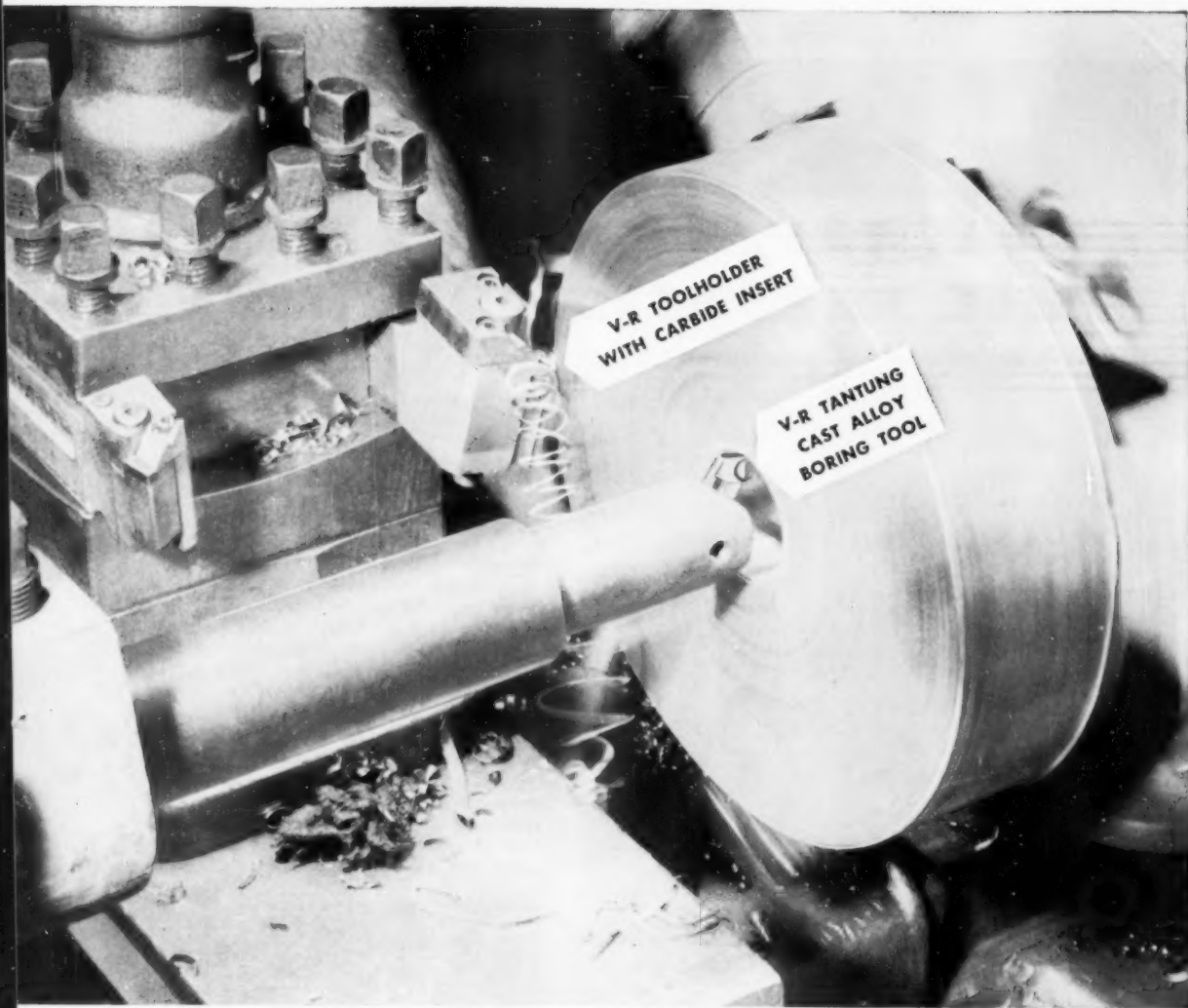
SURFACE SPEED TABLE and TOOL SELECTOR CHART

VASCOLEY-RAMET CORPORATION

General H.S. Steel Cutting Range							GENERAL TANTUNG CUTTING RANGE							General Carbide Cutting Range							SURFACE FEET PER MINUTE
SURFACE FEET PER MINUTE	40	50	60	70	80	90	100	110	120	140	160	180	200	250	300	350	400	450	500	600	
DIA. IN.	REVOLUTIONS PER MINUTE																				DIA. IN.
1/8	611	764	917	1070	1222	1375	1528	1681	1833	2140	2444	2750	3056	3820	4584	5348	6112	6882	7640	9168	1/8
1/4	306	382	458	534	611	688	764	840	916	1070	1222	1375	1528	1833	2140	2444	2750	3056	3820	4584	1/4
3/8	204	255	306	357	408	459	510	561	612	714	816	917	1019	1222	1425	1628	1831	2034	2440	2846	3/8
1/2	153	191	229	267	306	344	382	420	459	534	611	688	764	916	1070	1222	1375	1528	1833	2140	1/2
5/8	122	153	183	214	244	275	306	337	368	420	472	524	576	688	800	912	1024	1136	1344	1552	5/8
3/4	102	127	152	177	202	227	252	277	302	354	406	458	510	612	714	816	917	1019	1222	1425	3/4
7/8	92	115	138	161	184	207	230	253	276	328	379	430	481	584	688	791	894	997	1199	1402	7/8
1	82	103	124	145	166	187	208	229	250	292	343	394	445	548	651	754	857	960	1162	1365	1
1 1/8	72	91	110	129	148	167	186	205	224	266	317	368	419	522	625	728	831	934	1136	1339	1 1/8
1 1/4	62	79	96	113	130	147	164	181	200	242	293	344	395	498	599	702	805	908	1110	1313	1 1/4
1 3/8	52	66	81	96	111	126	141	156	171	213	264	315	366	469	570	673	776	879	1081	1284	1 3/8
1 1/2	42	54	65	77	89	101	113	125	137	179	220	261	302	405	506	609	712	815	1017	1220	1 1/2
1 5/8	32	41	50	59	68	77	86	95	104	146	187	228	269	372	473	576	679	782	984	1187	1 5/8
1 3/4	22	28	34	40	46	52	58	64	70	112	143	174	205	308	409	512	615	718	920	1123	1 3/4
1 7/8	18	22	27	32	37	42	47	52	57	99	129	159	189	292	393	496	599	702	904	1107	1 7/8
2	12	15	18	21	24	27	30	33	36	78	108	138	168	271	372	475	578	681	883	1086	2
2 1/8	10	12	15	17	20	22	25	27	30	72	102	132	162	265	366	469	572	675	877	1080	2 1/8
2 1/4	9	11	13	15	17	19	21	23	25	67	97	127	157	260	361	464	567	670	872	1075	2 1/4
2 3/8	8	10	12	14	16	18	20	22	24	64	94	124	154	257	358	461	564	667	869	1072	2 3/8
2 1/2	7	9	11	13	15	17	19	21	23	61	91	121	151	254	355	458	561	664	866	1069	2 1/2
2 5/8	6	8	10	12	14	16	18	20	22	59	89	119	149	252	353	456	559	662	864	1067	2 5/8
2 3/4	5	7	9	11	13	15	17	19	21	56	86	116	146	249	350	453	556	659	861	1064	2 3/4
2 7/8	4	6	8	10	12	14	16	18	20	54	84	114	144	247	348	451	554	657	859	1062	2 7/8
3	4	5	7	9	11	13	15	17	19	51	81	111	141	244	345	448	551	654	856	1059	3
3 1/8	3	5	6	8	10	12	14	16	18	49	79	109	139	242	343	446	549	652	854	1057	3 1/8
3 1/4	3	4	6	8	10	12	14	16	18	46	76	106	136	239	340	443	546	649	851	1054	3 1/4
3 3/8	2	4	5	7	9	11	13	15	17	44	74	104	134	237	338	441	544	647	849	1052	3 3/8
3 1/2	2	3	5	7	9	11	13	15	17	41	71	101	131	234	335	438	541	644	846	1049	3 1/2
3 5/8	2	3	4	6	8	10	12	14	16	39	69	99	129	232	333	436	539	642	844	1047	3 5/8
3 3/4	1	3	4	5	7	9	11	13	15	36	66	96	126	229	330	433	536	639	841	1044	3 3/4
3 7/8	1	2	3	5	7	9	11	13	15	34	64	94	124	227	328	431	534	637	839	1042	3 7/8
4	1	2	3	4	6	8	10	12	14	31	61	91	121	224	325	428	531	634	836	1039	4
4 1/8	1	2	3	4	5	7	9	11	13	29	59	89	119	222	323	426	529	632	834	1037	4 1/8
4 1/4	1	2	3	4	5	7	9	11	13	26	56	86	116	219	320	423	526	629	831	1034	4 1/4
4 3/8	1	2	3	4	5	7	9	11	13	24	54	84	114	217	318	421	524	627	829	1032	4 3/8
4 1/2	1	2	3	4	5	7	9	11	13	21	51	81	111	214	315	418	521	624	826	1029	4 1/2
4 5/8	1	2	3	4	5	7	9	11	13	19	49	79	109	212	313	416	519	622	824	1027	4 5/8
4 3/4	1	2	3	4	5	7	9	11	13	17	47	77	107	210	311	414	517	620	822	1025	4 3/4
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5	1	2	3	4	5	7	9	11	13	14	42	72	102	205	306	409	512	615	817	1020	5
5 1/8	1	2	3	4	5	7	9	11	13	12	40	70	100	203	304	407	510	613	815	1018	5 1/8
5 1/4	1	2	3	4	5	7	9	11	13	11	38	68	98	201	302	405	508	611	813	1016	5 1/4
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5 5/8	1	2	3	4	5	7	9	11	13	8	32	62	92	195	296	399	502	605	807	1010	5 5/8
5 3/4	1	2	3	4	5	7	9	11	13	7	30	60	90	193	294	397	500	603	805	1008	5 3/4
5 7/8	1	2	3	4	5	7	9	11	13	6	28	58	88	191	292	395	498	601	803	1006	5 7/8
6	1	2	3	4	5	7	9	11	13	5	26	56	86	189	290	393	496	599	801	1004	6
6 1/8	1	2	3	4	5	7	9	11	13	4	24	54	84	187	288	391	494	597	799	1002	6 1/8
6 1/4	1	2	3	4	5	7	9	11	13	4	22	52	82	185	286	389	492	595	797	1000	6 1/4
6 3/8	1	2	3	4	5	7	9	11	13	3	20	50	80	183	284	387	490	593	795	998	6 3/8
6 1/2	1	2	3	4	5	7	9	11	13	3	18	48	78	181	282	385	488	591	793	996	6 1/2
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6 3/4	1	2	3	4	5	7	9	11	13	2	14	44	74	177	278	381	484	587	789	992	6 3/4
6 7/8	1	2	3	4	5	7	9	11	13	1	12	42	72	175	276	379	482	585	787	990	6 7/8
7	1	2	3	4	5	7	9	11	13	1	10	40	70	173	274	377	480	583	785	988	7

← HIGH SPEED STEEL → ← TANTUNG → ← CEMENTED CARBIDE →

TO USE THIS CHART find the proper surface speed and refer to the work diameter columns at extreme right or left. The correct R.P.M. is shown opposite the work diameter to be turned.



Turning and boring normalized oil hardening Tool Steel 8" O.D. and 2" I.D.

How to Calculate Surface Feet Per Minute

GIVEN from chart at left: 215 RPM is called for to turn 8" O.D. at 450 SFPM

TO FIND surface speed of 2" I.D., use formula:

$$\text{SFPM} = \text{Dia. of work} \times .262 \times \text{RPM}$$

$$\text{or SFPM} = 2 \times .262 \times 215 = 112.6$$

Operation	SFPM	RPM	Tool	Comments
Turn 8" O.D.	450	215	Carbide	Surface speed too fast for anything but carbide.
Bore 2" I.D.	112.6	215	Tantung	Surface speed too slow for carbide, too fast for high speed steel.

FREE: Tool Selector Chart and Catalogs

CHART. The complete, handy pocket size Tool Selector Chart shown on the left hand page is available free on request without obligation. Send for your copy today.

CATALOGS. Complete data on V-R Tantung cast alloy cutting tools, Carbides and Toolholders is contained in separate catalogs available on request.



MANUFACTURERS OF:
CEMENTED CARBIDES, TOOLHOLDERS and TANTUNG® CAST ALLOY CUTTING TOOLS

Vascoloy-Ramet Corporation

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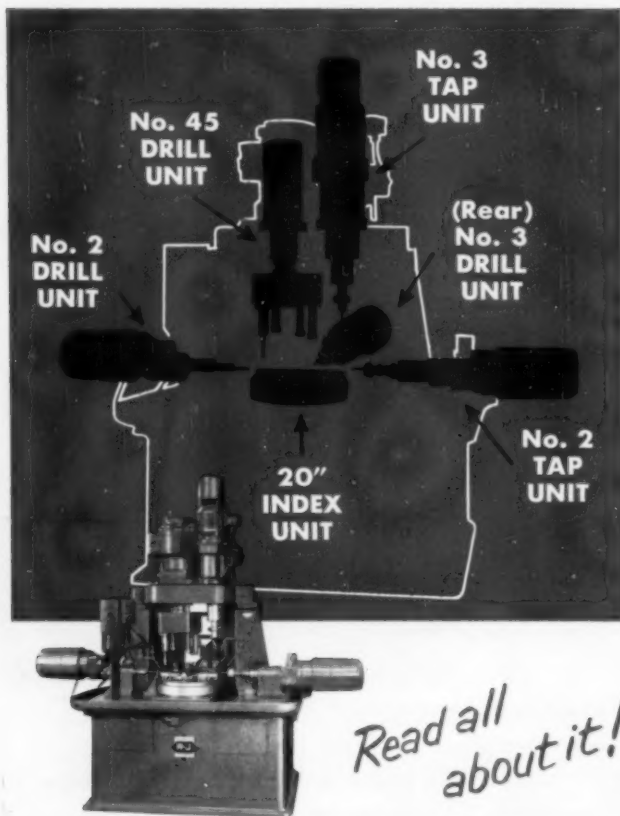
August 1956

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-33

33

REHNBERG-JACOBSON

DRILL, TAP, AND INDEX UNITS MAKE VERSATILE MACHINES



*Here's an example
of how it is done*

At the left you can see how several different R-J ALL-MECHANICAL Drill, Tap, and Index Units have been mounted on a base-and-column structure to produce a complete automatic production machine tool. Each of the several types of units is made in a range of sizes, sufficient to cover the great majority of ordinary machining operations. The units are easy to mount and can be arranged horizontally, vertically, or at any angle as desired. The machine shown, for example, drills, taps, faces, counterbores, and performs a simple serration operation on a steel forging. If a design change in the piece should occur, the machine can be easily and quickly altered to handle any new requirements. *R-J Units are all available separately, so YOU can assemble or modify your own production machines.*

*Read all
about it!*

The whole story of R-J ALL-MECHANICAL Units is presented in full detail in this handsome and useful 43-page book — which is available FREE on request. Here you will find individual and fully-detailed specification sheets on all types and sizes of R-J ALL-MECHANICAL Drill, Tap, and Index Units. From this information, you can see exactly how any unit will fit any contemplated machine, and the capacity it has for handling various operations. In addition, basic wiring diagrams are furnished for all units, including interconnections for automatic sequence operations. Finally, the book contains a score of outstanding examples of production machines that have been designed and built by Rehnberg-Jacobson, showing many practical ways in which R-J ALL-MECHANICAL Units have been successfully used.



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BOOK!**

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AVAILABLE
for PROMPT
DELIVERY**



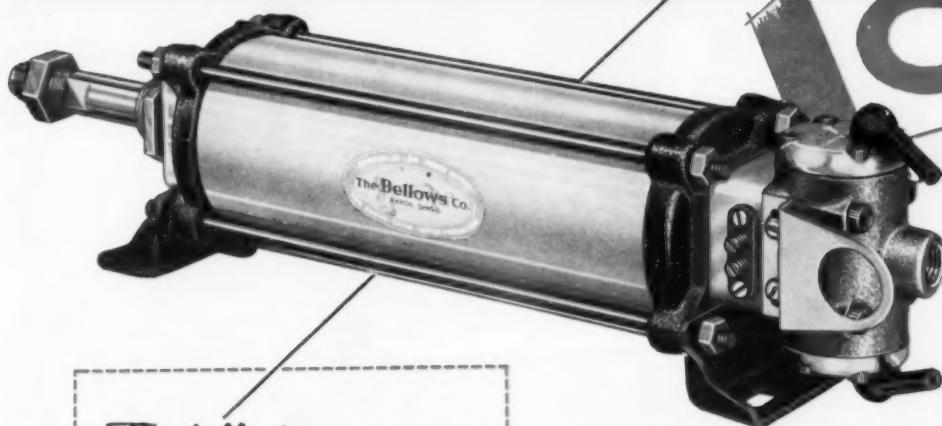
**REHNBERG-JACOBSON
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**DESIGNERS, ENGINEERS
MANUFACTURERS AND
PRODUCTION CONSULTANTS**

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Air Cylinder Power

The BELLOWS AIR MOTOR



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for the asking—*



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It's as simple as ABC — "control" is the essential difference that makes Bellows Air Motors do a better job at lower cost than conventional air cylinders.

In Bellows Air Motors control is an *integral part* of the air cylinder. There are no extra valves to buy — no complicated and cumbersome piping to install. The Bellows Air Motor is a complete power unit in itself.

What does it mean in terms of

- BETTER PERFORMANCE?
- GREATER ECONOMY?

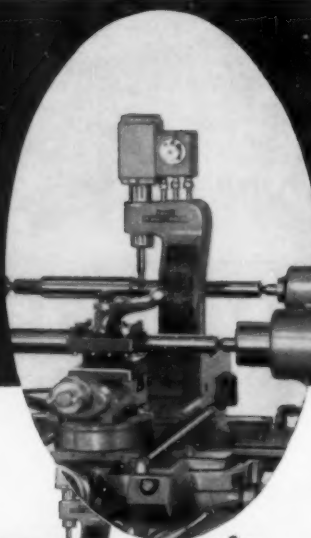
It means instant action. The moment you shift the valve (either electrically or mechanically) the piston responds. No hesitancy — no chatter — no delay. It means simpler installation, easier interlock; "Controlled-Air-Power" fits in naturally with related machine movements. It means lower installed cost — lower maintenance costs.

418-B

The Bellows Co.
AKRON 9, OHIO

No matter
how complex

or unusual the
work pieces...



Sidney Model 32 Dial-Master Engine or Tool Room Lathe equipped with Sidney Fluid Tracer



**30 OR MORE HYDRAULICALLY
CONTROLLED PRE-SELECTIVE
SPINDLE SPEEDS**

A revolutionary innovation and presented as a "SIDNEY FIRST" as long ago as the Machine Tool Show of 1947 . . . used regularly as a standard SIDNEY feature ever since. But only recently adapted by other lathe manufacturers . . . a fitting tribute to SIDNEY pioneering and leadership.

the SIDNEY FLUID TRACER HEAD

instantly, precisely and uniformly transfers every change in contour from the master piece or template to the cutting tool. It also controls the hydraulically actuated cross feed and the longitudinal movement of the carriage.

THE SIDNEY FLUID TRACER can be furnished in connection with any size or model of SIDNEY LATHE. Small runs or quantity production runs show tremendous savings in cost per finished piece. Changeover to standard lathe operation or back to tracer control requires just a few seconds. No addition or removal of parts is necessary because the tracer motor may be turned off while the lathe does standard lathe work.

Look at what work you can turn with the SIDNEY FLUID TRACER attachment:

IT'S "SUPER" IN EVERY WAY

SUPER SWIFT...

SUPER ECONOMICAL...

SUPER SENSITIVE!

Write for new bulletins or ask for
representative to call



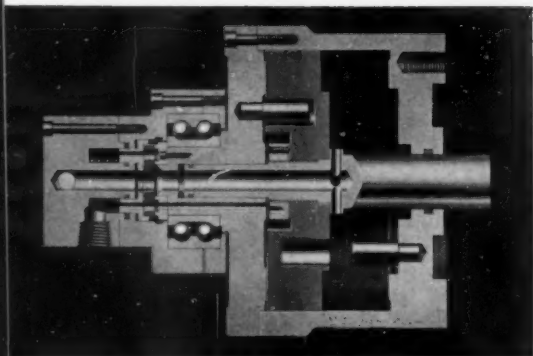
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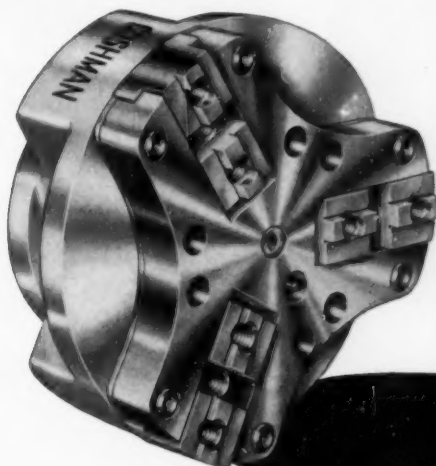
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give Chuck-ability

CHUCK-ABILITY: The ability to **SPEED** your work
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Typical Cushman Air Operated Chucks and Cylinders for repetitive machining operations permitting increased production at lower costs.

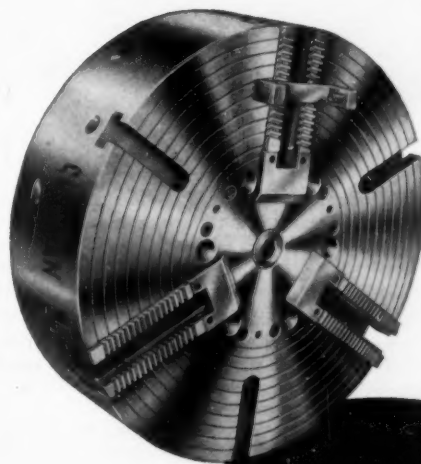


the key to machining efficiency

Today's repetitive manufacturing demands *efficient* and *economical* operation of high speed machine tools. Cushman Air Operated Chucks and Cylinders give you **Chuck-ability** with satisfactory performance under the punishment of constant day-in and day-out service ... no loss of chuck or cylinder efficiency over a long service life ... no air leakage problems ... and the feature of quick loading and unloading of work-pieces at the touch of foot or hand.

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Write today for catalogs fully describing Cushman Chucks. Or, should you have a particular work-holding problem, Cushman can give you **Chuck-ability** in a special chuck, designed and engineered to your requirements.



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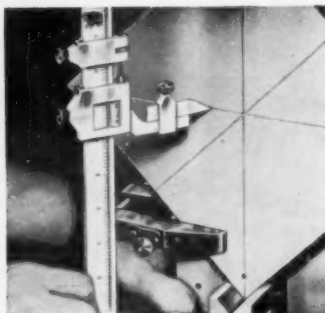
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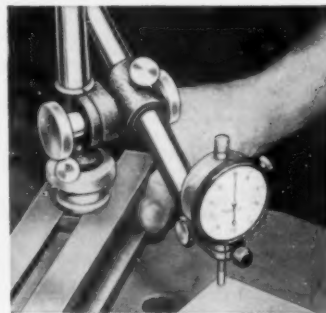
NEW CATALOG No. 27

Shows the complete Starrett line. Ask your Industrial Supply Distributor or write for free copy. Address Dept. E, The L. S. Starrett Company, Athol, Massachusetts, U. S. A.



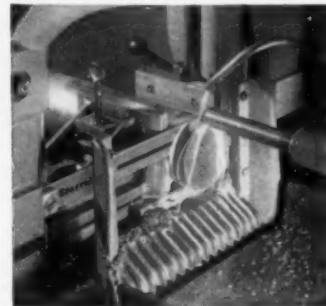
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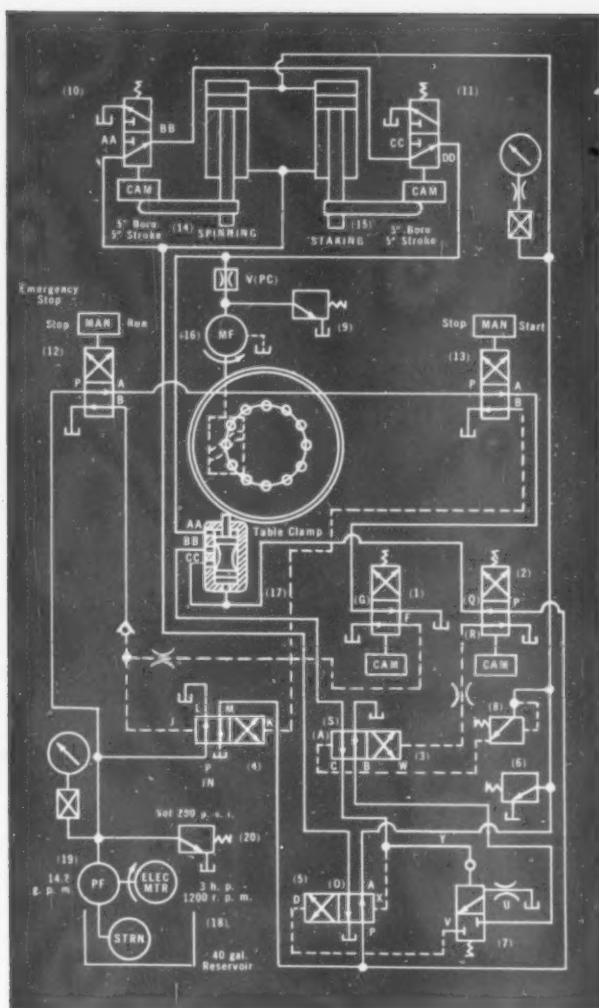
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Properly Designed . . . Properly Equipped By Logan

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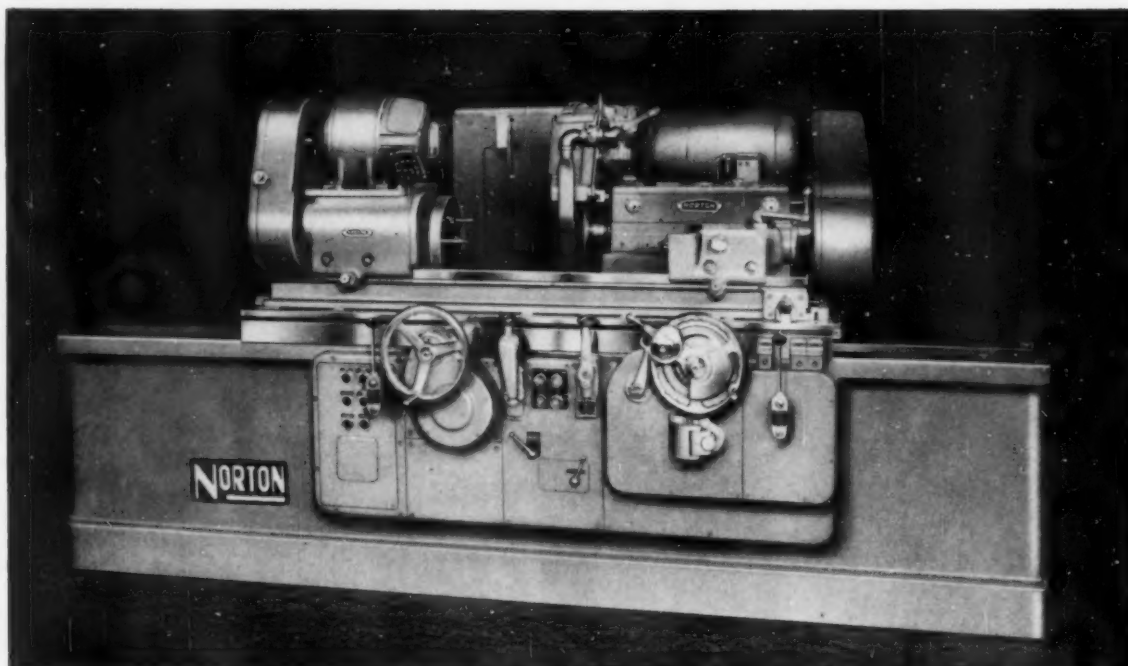
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A NORTON TYPE CTU SEMIAUTOMATIC CYLINDRICAL GRINDER. The fastest, most economical and versatile grinding machine of its type. One-lever control of the automatic grinding cycle reduces the operator's duties to loading and unloading. Both the 6" and 10" Type CTU's are available as semiautomatics or as plain machines.

Norton Type CTU Cylindrical Grinders

are packed with
features for...



Production line and job shop users report that Norton 6" and 10" Type CTU cylindrical grinders have doubled and tripled production, replaced several machines and eliminated costly extra operations.

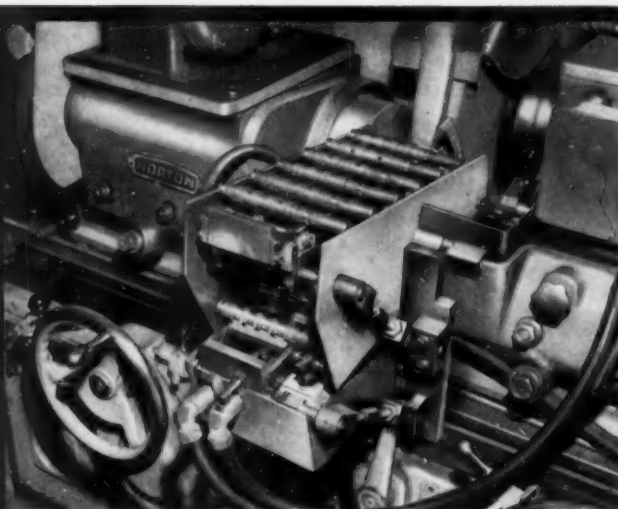
That's because of the many time-and-work-saving "Touch of Gold" features — standard and auxiliary — available with these grinders.

Some of the expertly automated auxiliary features are

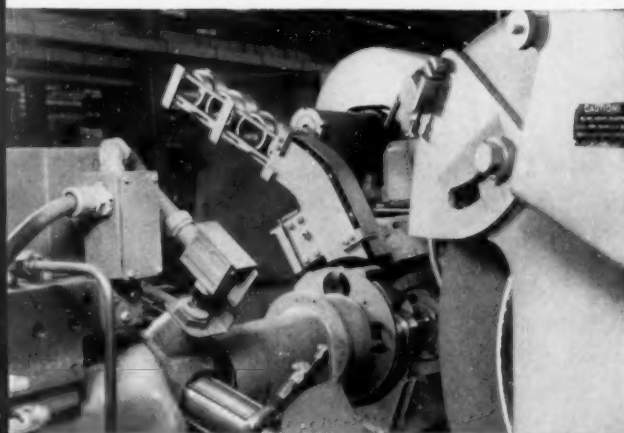
described here. Check them carefully — and figure their value to your own cylindrical grinding operations. And remember: only Norton offers you such long experience in both grinding machines and wheels to bring you the "Touch of Gold" that helps you produce more at lower cost. For further facts, see your Norton Representative, or write to NORTON COMPANY, Machine Division, Worcester 6, Mass. In Canada: J. H. Ryder Machinery Co., Ltd., Toronto 5.



THE SWIVALIGN* ELIMINATES CUT-AND-TRY. Another Norton "Touch of Gold" development for faster, better, lower cost grinding. The SWIVALIGN Dual Electric Indicator, available for Norton cylindrical and universal grinders, enables operators to adjust the angular positions of swivel tables quickly and accurately, eliminating the usual cut-and-try guesswork. Featuring positive response and easy operation, this accurate instrument saves grinding time and money.

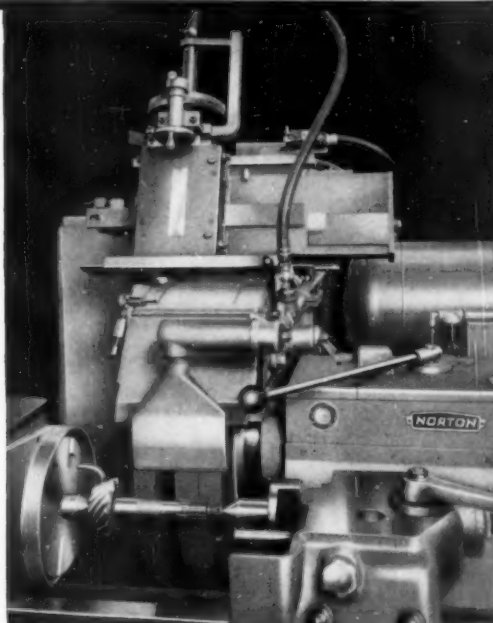


RAIL TYPE



TURRET TYPE

YOUR CHOICE OF AUTOMATIC LOADING DEVICES. Two types of Norton automatic loading devices are obtainable with 6" and 10" Type CTU semiautomatic grinders. The rail type loader is designed to handle a variety of small shafts. The turret type loader handles workpieces which must be chucked. Thanks to their steadily paced, automatic operation these Norton-developed loading mechanisms can be adapted to full automation. Or, they make it possible for one operator to tend a battery of machines, speeding production and cutting unit costs day after day.



WHEEL HEAD MOUNTED AUTOMATIC TRUING OFFERS BIG ADVANTAGES. A Norton automatic truing device, as shown here on a Type CTU grinder, quickly repays its original cost. It speeds up production, increases wheel life and increases diamond life. Also, it decreases the skill and effort required with hand truing. Operation is extremely simple. Once the original settings are made, all you do is push a button. Then the diamond automatically makes its round trip across the wheel face, at pre-determined speed and feed. Easy adjustments assure correct settings for each job . . . Another step forward in automatic grinding!

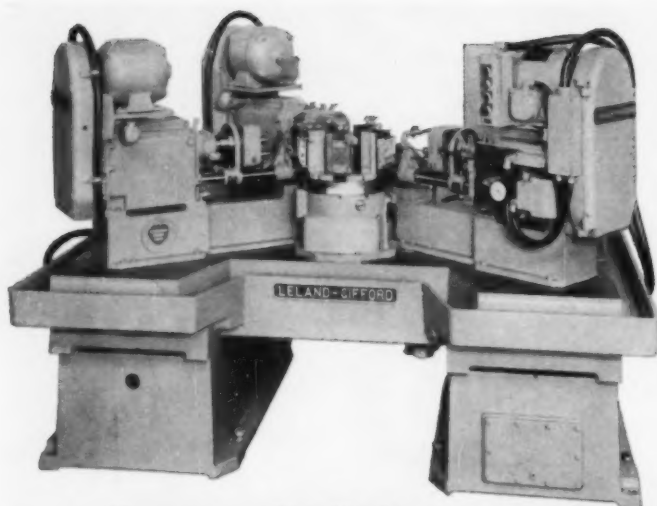
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*SWIVALIGN — Norton trade name for Dual Electric Indicator for accurate measurements of swivel table adjustment.



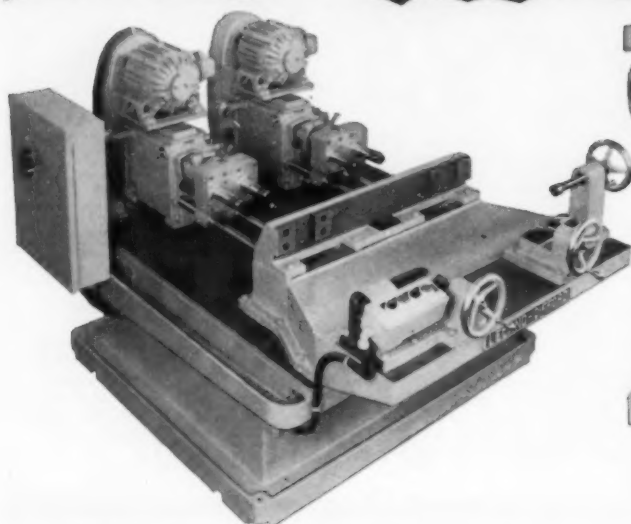
Mechanize Hand Operations

THE JOB — Drill and ream four holes on the face and two ends of automatic transmission valve body.

THE SETUP — Three No. 2 self-contained deep hole units with 2-spindle multiple heads and a 5-station hydraulic indexing station. Production: up to 120 pieces per hour.

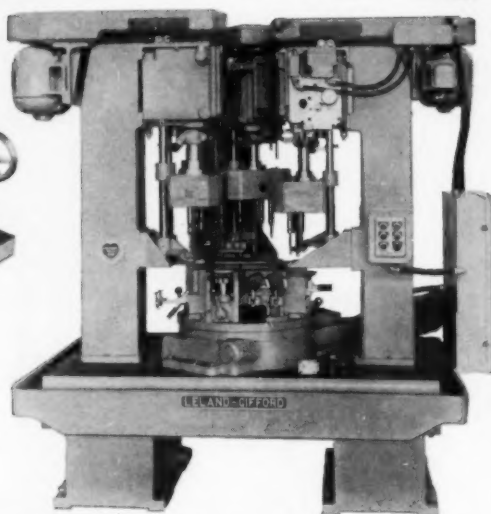
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Special Drilling Machines



THE JOB — Drill and ream two .750/.751 dowel holes in 4 and 6-cylinder engine blocks.

THE SETUP — Two No. 3 self-contained units with 2-spindle heads mounted on a special base with work holding and positioning fixture.



THE JOB — Drill and ream 9 holes in one face and 2 deep angular holes in one side and one end of a control valve housing.

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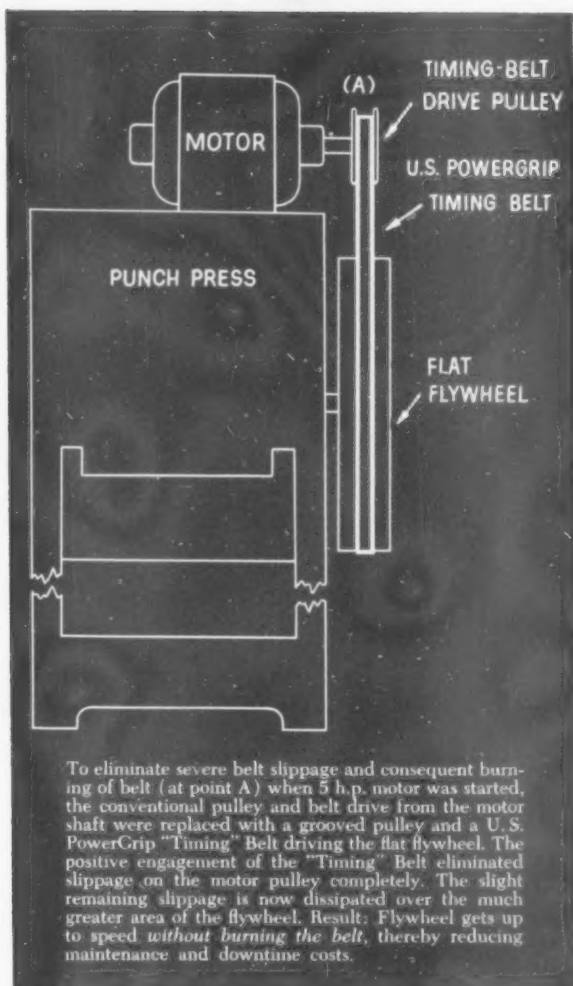
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To eliminate severe belt slippage and consequent burning of belt (at point A) when 5 h.p. motor was started, the conventional pulley and belt drive from the motor shaft were replaced with a grooved pulley and a U.S. PowerGrip "Timing" Belt driving the flat flywheel. The positive engagement of the "Timing" Belt eliminated slippage on the motor pulley completely. The slight remaining slippage is now dissipated over the much greater area of the flywheel. Result: Flywheel gets up to speed *without burning the belt*, thereby reducing maintenance and downtime costs.

How a plant engineer
made this press
deliver a
better punch



This is one more example of the U.S. PowerGrip "Timing"® Belt's ability to simplify and improve a power transmission unit . . . one of the reasons why the invention of this belt was recently awarded the Franklin Institute's Edward Longstreth Medal for "Invention of High Order."

Whether it's a plant conversion or original equipment design problem, U.S. PowerGrip "Timing" Belts offer the plant and design engineer all these advantages:

- no slippage, no take-up—allows short centers, high ratios.
- absence of metal-to-metal contact—eliminates need for lubrication and housing devices.
- handles speeds up to 16,000 F.P.M. or so slow as to be imperceptible to the eye.
- close to 100% efficiency.
- imbedded with steel cables for high tensile strength.
- constant angular velocity.

These belts—plus expert engineering service—are obtainable at "U.S." power transmission distributors, at any of the 28 "U.S." District Offices, or by writing us at Rockefeller Center, New York 20, N. Y.



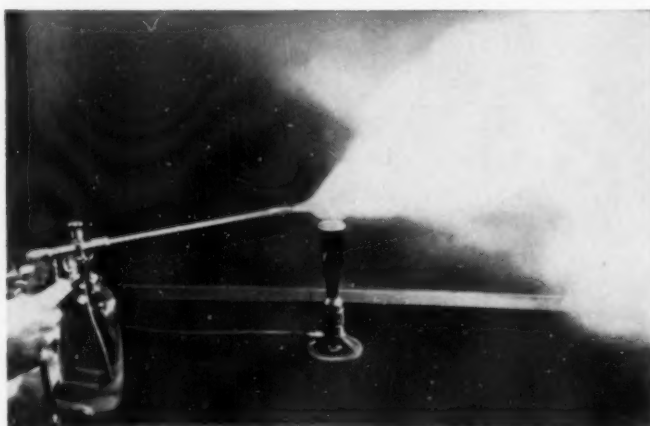
Mechanical Goods Division

United States Rubber

Announcing...the First HYDRAULIC

Flame tests prove its fire-snuffing ability

This photo shows the instant combustion taking place when a conventional hydraulic oil of mineral oil type is atomized over a Bunsen burner.



In this photo, Shell Irus Fluid 902 replaces the mineral oil. Note that there is no ignition.



SHELL IRUS FLUID 902

Oil-Base fire-resistant

FLUID

SHELL IRUS FLUID 902

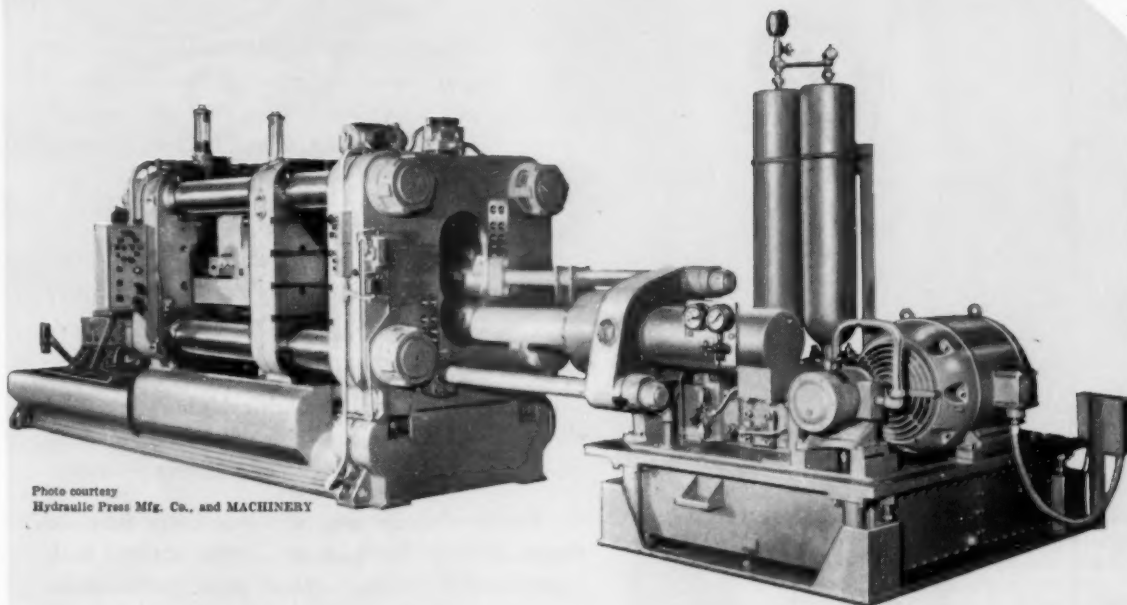


Photo courtesy
Hydraulic Press Mfg. Co., and MACHINERY

AFTER THREE YEARS of intensive research, field application and evaluation, Shell IruS Fluid 902 is now commercially available for use in industrial hydraulic systems. While its cost is far lower than other fire-resistant fluids, its performance is comparable.

No major modification of equipment is necessary. Shell IruS Fluid 902 is a special formulation containing no corrosive ingredients . . . no adverse effect on seals or fittings.

It is a direct replacement for hydraulic oils now in service.

Noncorrosive, and nonrusting. Steel and copper panels immersed in IruS Fluid 902 for one week at 160°F have shown no significant signs of corrosion. Rusting has not been a problem in long-continued field tests.

This is an efficient fire-snuffing hydraulic fluid that can be widely used. Send coupon for details.

SHELL OIL COMPANY

50 WEST 50 STREET, NEW YORK 20, NEW YORK

100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA



SHELL OIL COMPANY

50 West 50th St. or 100 Bush St.
New York 20, N. Y. San Francisco 6, Cal.

Please send me test data and information on Shell IruS Fluid 902.

Name

Company

Address

**Controlled* MEASURE



The science of measure plays an important role in the inventive genius of man . . . from the proper assembly of the simplest kitchen gadget to the complex construction of the record-holding "United States".

Bath gages . . . a tool of this science . . . are preferred by leading manufacturers for dependable part inspection because of the extra ingredient of built-in quality and precision that assures CM. . .
*controlled measure!

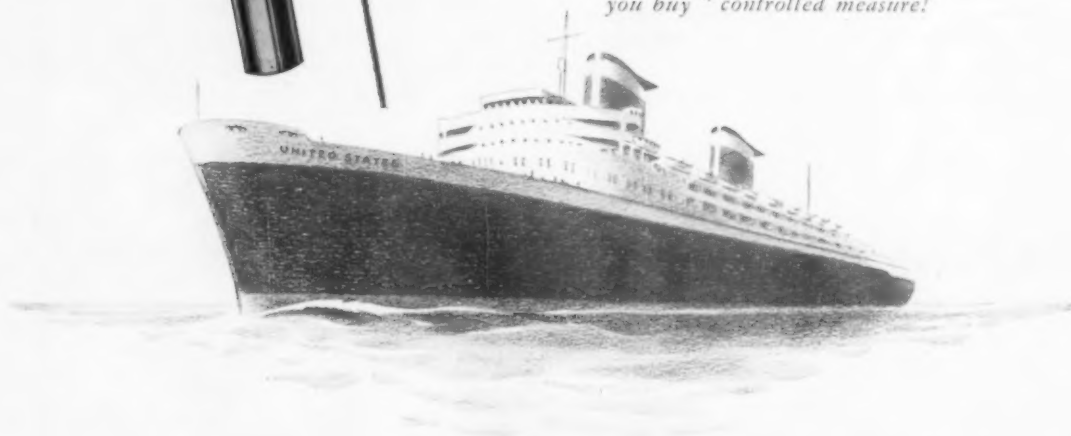
Whether it's Bath cylindrical plug or thread, ring or reversible gages — they're precision-made to exact specifications for accuracy and long wear-life.

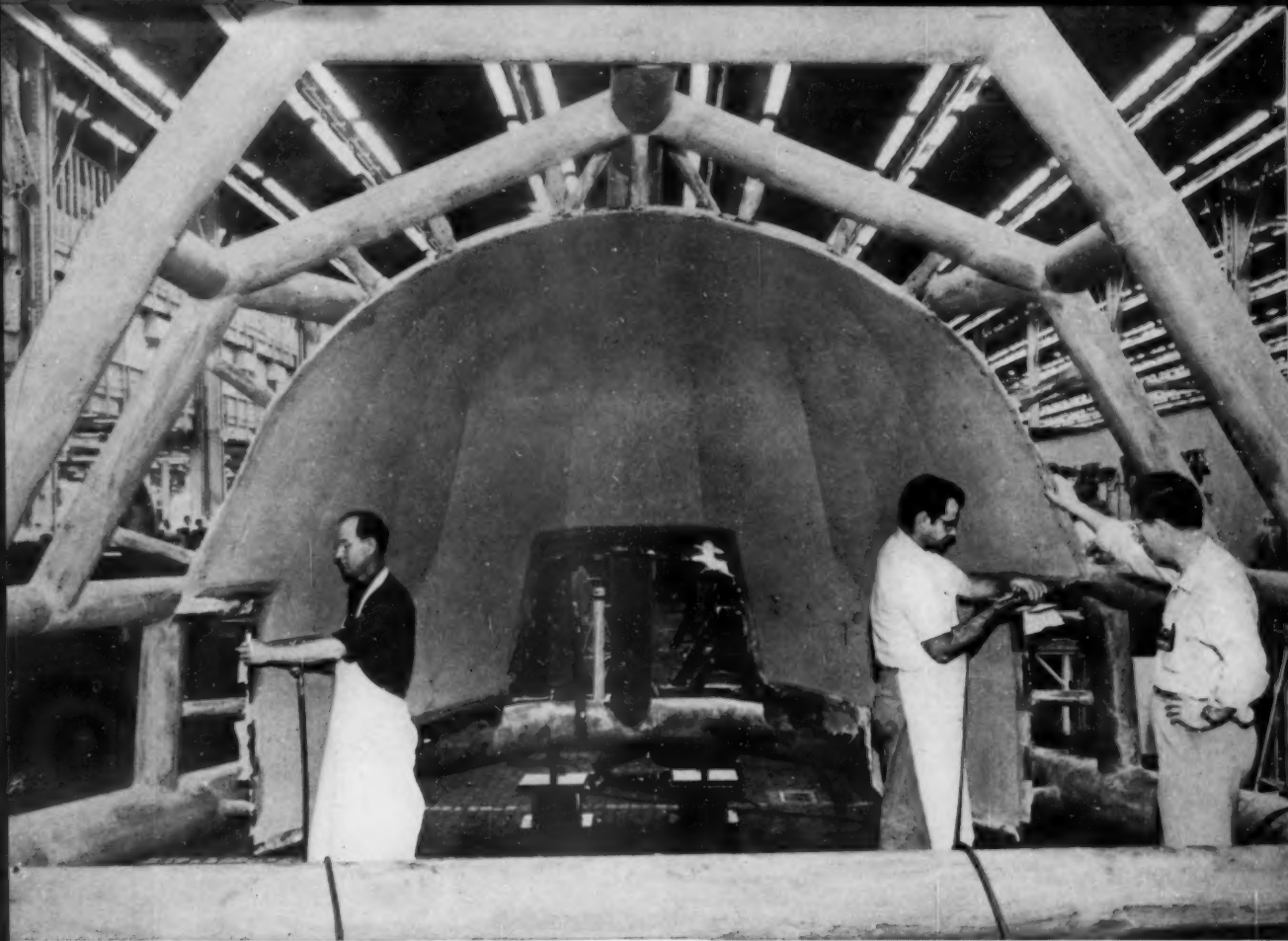
The fit of component parts is no better than the degree of controlled measure . . . why not let a Bath representative improve your gage performance.

JOHN BATH & CO. Inc.
28 Grafton St., Worcester, Mass.

CYLINDRICAL AND THREAD GAGES • GROUND THREAD TAPS
INTERNAL MICROMETERS

*When you buy Bath Gages . . .
you buy *controlled measure!*





Probably the largest plastic tool ever made, this master gauge checks alignment of the entire upper front window area on the Lockheed Hercules C-130, first U.S. prop-jet transport. Pressurized fuselage demands tight, accurate fit between sections. Gauge shell is laminate of glass cloth and compounds based on BAKELITE Brand Epoxy Resins. Frame is normalized steel, 18 feet wide, 14 feet deep, 9 feet high. Compounds used are produced by Rezolin, Inc., Los Angeles 45, Calif.

Plastic tools get bigger



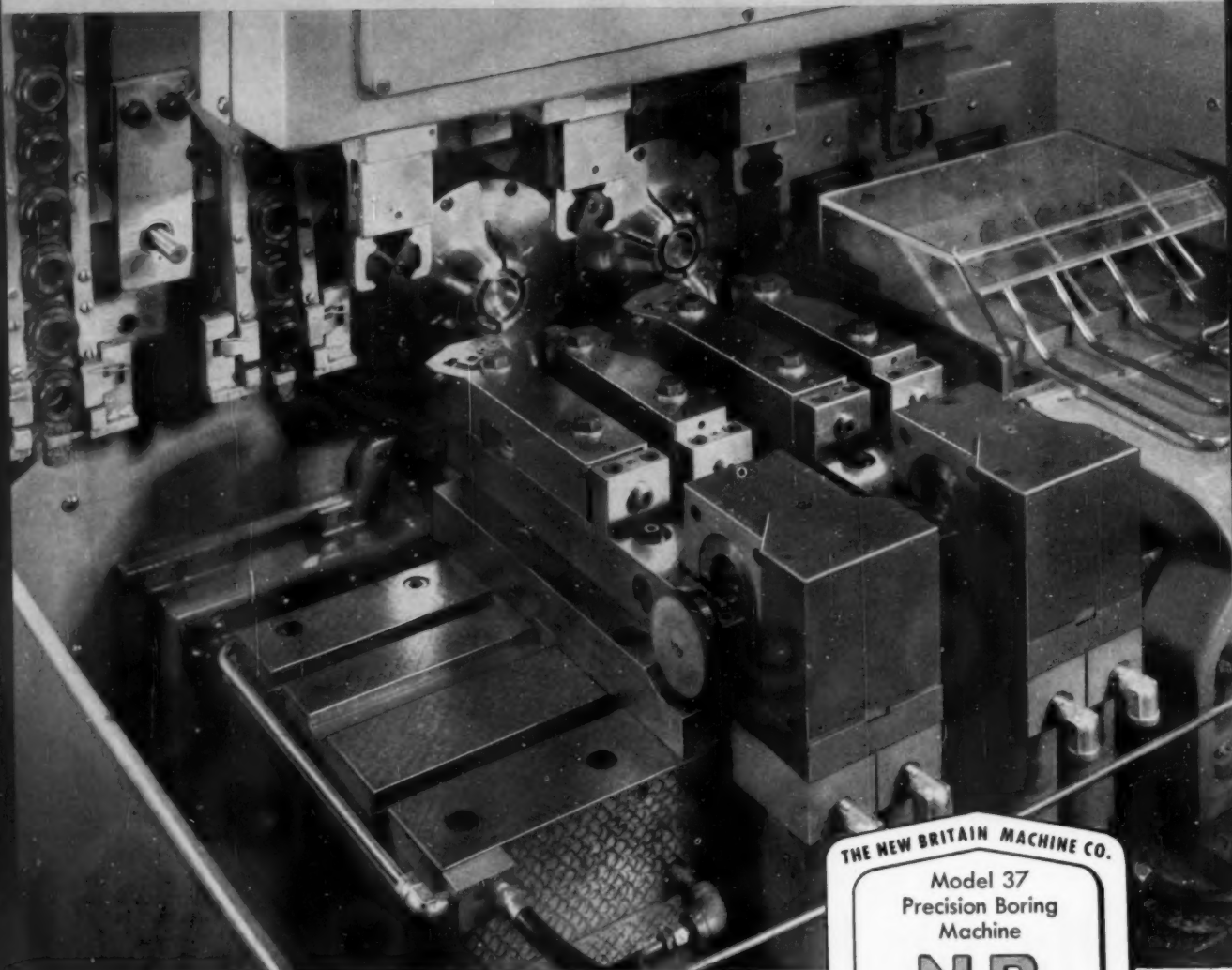
Regardless of size, plastic tools can mean big savings where model changes are fast and frequent.

Metal and plastic products alike can be formed with epoxy compounds. Based on BAKELITE Brand Epoxy Resins, these liquid compounds speed tooling operations because they're easier to work with. They can be formed at room tem-

perature without pressure. They quickly harden with minimum shrinkage. Finished tools have excellent dimensional stability, mechanical strength, and light weight. That's why so many jigs, Keller models, spotting racks, and checking fixtures are being made from glass cloth and "Rezolin" compounds based on BAKELITE Epoxy Resins.



BAKELITE COMPANY, A Division of Union Carbide and Carbon Corporation **UCC** 30 East 42nd Street, New York 17, N. Y.
The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC



THE NEW BRITAIN MACHINE CO.

Model 37
Precision Boring
Machine

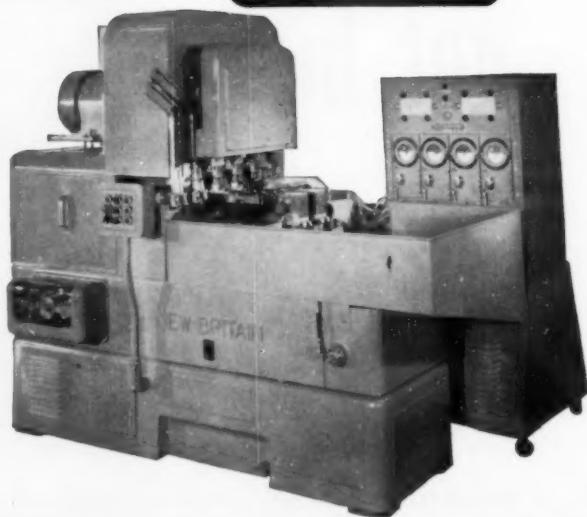
NB

here's fully automatic precision turning and boring

This Model 37 New Britain is a down-to-earth money-making application of automated machining—made practical by automatic loading, *plus* high-spindle speeds, *plus* multiple-spindle production, *plus* automatic gauging, *plus* automatic adjustment of each tool.

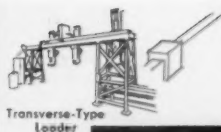
These modern machines, with or without automatic controls, will enable you to make simple work of tough jobs involving such operations as step turning, step boring, boring and facing, turning and facing, grooving, recessing, chamfering or generating contours. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

Available in a complete line of horizontal, vertical and double-end models.

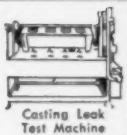




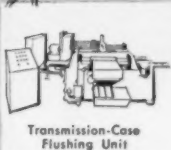
Production-Line Crankshaft Grinder



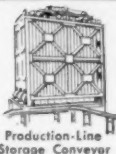
Transverse-Type Loader



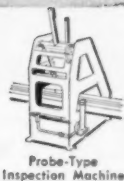
Casting Leak Test Machine



Transmission-Case Flushing Unit



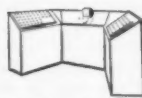
Production-Line Storage Conveyor



Probe-Type Inspection Machine



Metal Fastener Assembly Equipment



Electrical Controls And Detector Systems

Builders of Better Machines and Equipment Since 1872

For a practical solution to your automation problems . . .

CALL ON W. F. & JOHN BARNES . . . SPECIAL TWO-FOLD COORDINATED SERVICE SOLVES PROBLEMS QUICKLY

More and more production executives than ever before are today turning to Barnes for help in designing and building specialized automation equipment. With 80 years of practical machine building experience, Barnes have been called upon to design and build hundreds of different types of automatic handling and special processing equipment as well as special high production machine tools. Now, to better serve demands and help you solve automation problems quickly, Barnes offers a two-fold coordinated service:

COMPLETE PRODUCTION-LINE ENGINEERING

1

If you are planning new production-line methods for either automatic or semi-automatic operations, an experienced engineering staff is available to work with you. The detailed plans and proposals submitted for your consideration can be depended upon to provide you with the latest in automation engineering and the very best of proven mechanical, hydraulic, and electrical actuation. Ask for a free survey of your problems early in your planning program.

DESIGNING & BUILDING SPECIALIZED UNITS

2

Designing and building specialized, individual units to suit your specific needs is a separate, additional service. Where required, electrical, mechanical, hydraulic, fixture, and tool engineers work together as a team. All efforts are closely coordinated with complete manufacturing facilities to save you time and eliminate divided responsibility. As illustrated, this service covers hundreds of different types of automatic processing and work-handling units that are today profitably serving a wide range of industrial needs.

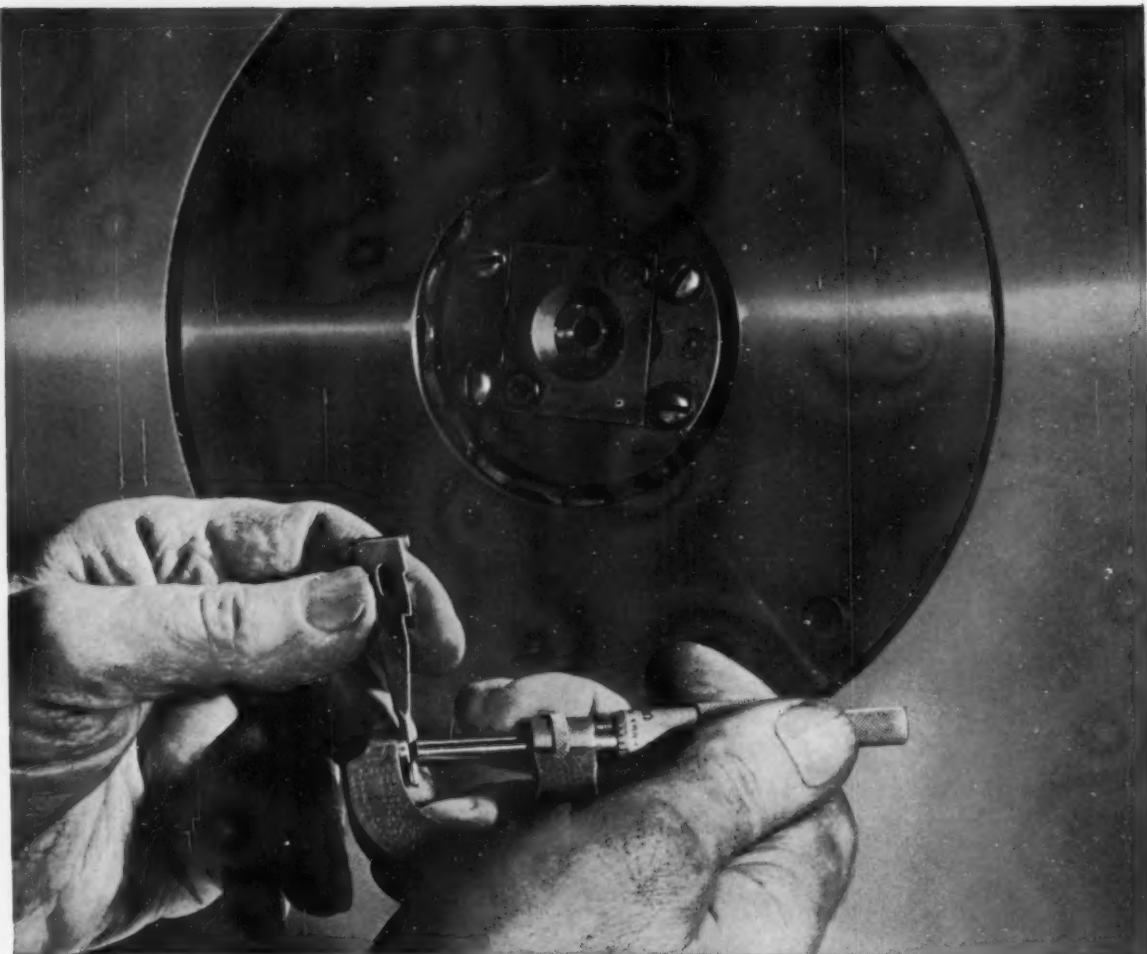
ANALYSIS OF METHODS — Call on Barnes engineers today for a practical solution to your automation problems. Or, ask for an analysis without obligation.



AUTOMATION SECTION

431 S. WATER ST. • ROCKFORD, ILLINOIS

SPECIAL MULTIPLE SPINDLE MACHINE TOOLS • SPECIAL PROCESS EQUIPMENT • SPECIAL ELECTRICAL CONTROLS



ROTARY SWAGING

produces precision work



and with an improved, highly burnished finish!

This firing pin was swaged to a tolerance of $\pm .001"$, compared to a tolerance of $\pm .003"$ when the part was turned. The switch to swaging eliminated ironing marks which had caused hardened pieces to break. No breakage was encountered after swaging.

Precision work can be performed rapidly with swaging in many different operations including reducing, tapering, pointing, sizing, bonding, forming inside contours or threads.

Send for our informative booklet on Torrington Swaging Machines, or ask to have a technical representative call to show you how you can benefit from rotary swaging.

THE TORRINGTON COMPANY
Swaging Machine Division
444 North Street, Torrington, Conn.



TORRINGTON ROTARY SWAGING MACHINES

Makers of Torrington Needle Bearings

Advantages of Rotary Swaging—

- 1 Savings in material**—swaging is chipless—shapes the work instead of cutting metal away.
- 2 Savings in labor**—swaging can be done by unskilled labor.
- 3 Improved products**—swaging improves grain structure, tensile strength, resiliency and finish. Produces work accurate to $\pm .001"$ and better.



Write for new catalog—It describes swaging benefits, covers selection of a swager, and gives specifications of Torrington's new streamlined Rotary Swaging Machines. Ask, too, to see our new motion picture on swaging.



compare with the standard
...in high speed steels
the standard's REX

Ever since grandad's day, Crucible's REX® high speed steel has been *the standard by which all other high speed steels are compared*. And now the quality and uniformity of REX are even *better*, thanks to improved manufacturing techniques at Crucible.

Don't take our word for it. Prove for yourself how REX leads in structure, uniformity, response to heat treatment, and fine tool performance.

Ask for REX at your nearby Crucible warehouse — or order it through prompt mill shipments. And, for a list of available data on all Crucible special purpose steels, write now for a free copy of the "Crucible Publication Catalog". *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America

August 1956

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-53

53

Gardner-Denver... Serving the World's Basic Industries

New tool balancers boost production... relieve fatigue

Seven new Keller Tool Balancers designed to increase production . . . reduce fatigue . . . prevent tool dropping damage. Three models for light suspension of screw drivers, nut setters, drills, tappers. Four models for heavy-duty balancing in 20—30—40—50 lb. capacities.

- ★ **LONG SERVICE**—oilless alloy bronze bearings.
- ★ **ADJUSTABLE CABLE STOP**—shock-resisting bumper.
- ★ **CABLE GUIDE**—keeps proper position on drums.
- ★ **STRAIGHT-LINE PULL**—eliminates excessive wear.

Many other features. Ask for Catalog Section 65.



GARDNER - DENVER

KELLER TOOL division, Grand Haven, Michigan

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS
FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY



1
COOLANT
THRU THE
WHEEL...

PRECISION PETE SAYS:

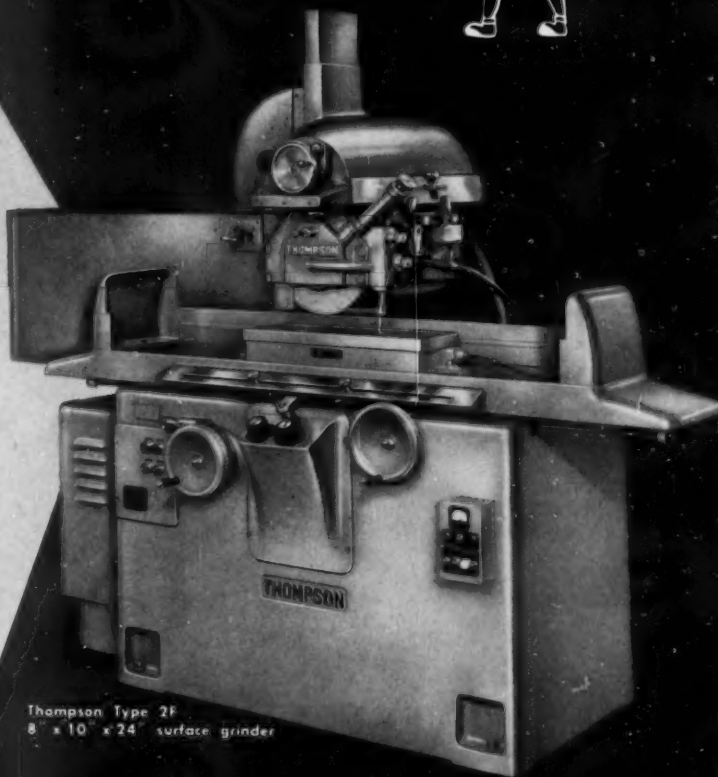
Only Thompson
Type 2F Grinder
has all three
available...



2
... COOLANT
EXTERNALLY ON
THE WORK...

... AND
"IN POSITION"
WHEEL
TRUING

3



Thompson Type 2F
8" x 10" x 24" surface grinder

MANUFACTURERS
OF THE WORLD'S
MOST COMPLETE LINE
OF SURFACE GRINDERS

WRITE TODAY FOR DESCRIPTIVE DATA

THE THOMPSON GRINDER COMPANY
SPRINGFIELD, OHIO

Thompson
SURFACE
Grinders

Made with **MAGNESIUM**



A FEW POUNDS make a big difference when jigs have to be moved manually several times an hour.

MAGNESIUM FOR LOW-COST TOOLING

Lightweight magnesium tooling plate costs less to buy, less to fabricate and less to use

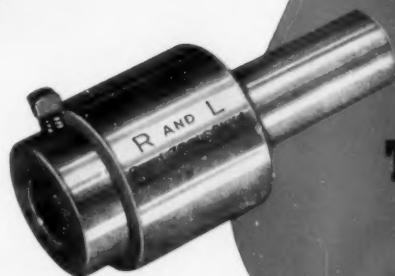
- **COSTS LESS TO BUY**—Jigs and fixtures made with magnesium cost you less in every way. Magnesium tooling plate costs less than commonly used lightweight tooling materials.
- **COSTS LESS TO FABRICATE**—Magnesium jigs and fixtures are easy and economical to build, too. The reason is that magnesium tooling plate is easy to machine, easy to weld. It has guaranteed flatness, excellent dimensional stability and freedom from porosity.
- **COSTS LESS TO USE**—Handling costs are also lower when you use magnesium tooling plate. Magnesium weighs one fourth as much as steel and only two thirds the weight of aluminum. By making your jigs and fixtures with lightweight magnesium you'll increase worker efficiency and reduce lost-time injuries.

For more information about magnesium tooling plate contact your nearest supplier of Dow magnesium, or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. MA 371L-1.

AVAILABLE FROM STOCK AT: Copper and Brass Sales, Inc., Detroit, Mich. • Fullerton Steel and Wire Company, Chicago, Ill. • Hubbell Metals Inc., St. Louis, Mo. • A. E. Purdy Co., Inc., Lyndhurst, N. J. • Reliance Magnesium Company, Los Angeles, Calif. • Vinson Steel and Aluminum Co., Dallas, Texas.

you can depend on DOW MAGNESIUM

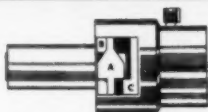




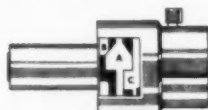
with **R and L** TAP AND DIE HOLDERS



*New Release Mechanism
allows for easy adjustment
for right or left hand
tapping and threading.*



Ready to start threading operation, clutch slightly engaged at C.



Instantly engaged to full contact between A and C as soon as tap or die engages work.



Fully released showing ample clearance between contact points of clutch.

Instant engagement
at full contact . . . Fast
kick out clutch . . . No spring
plungers to wear or break . . .

No small screws to work loose!

Available with shanks of from $\frac{5}{8}$ " to $1\frac{1}{2}$ "
in releasing and non-releasing types as well as
releasing die holders for acorn dies.

Send for new
catalog

R and L TOOLS

1825 Bristol Street, Philadelphia 40, Pa.

- ☐ Send new catalog
☐ Please have representative call.

NAME

COMPANY

ADDRESS

.....

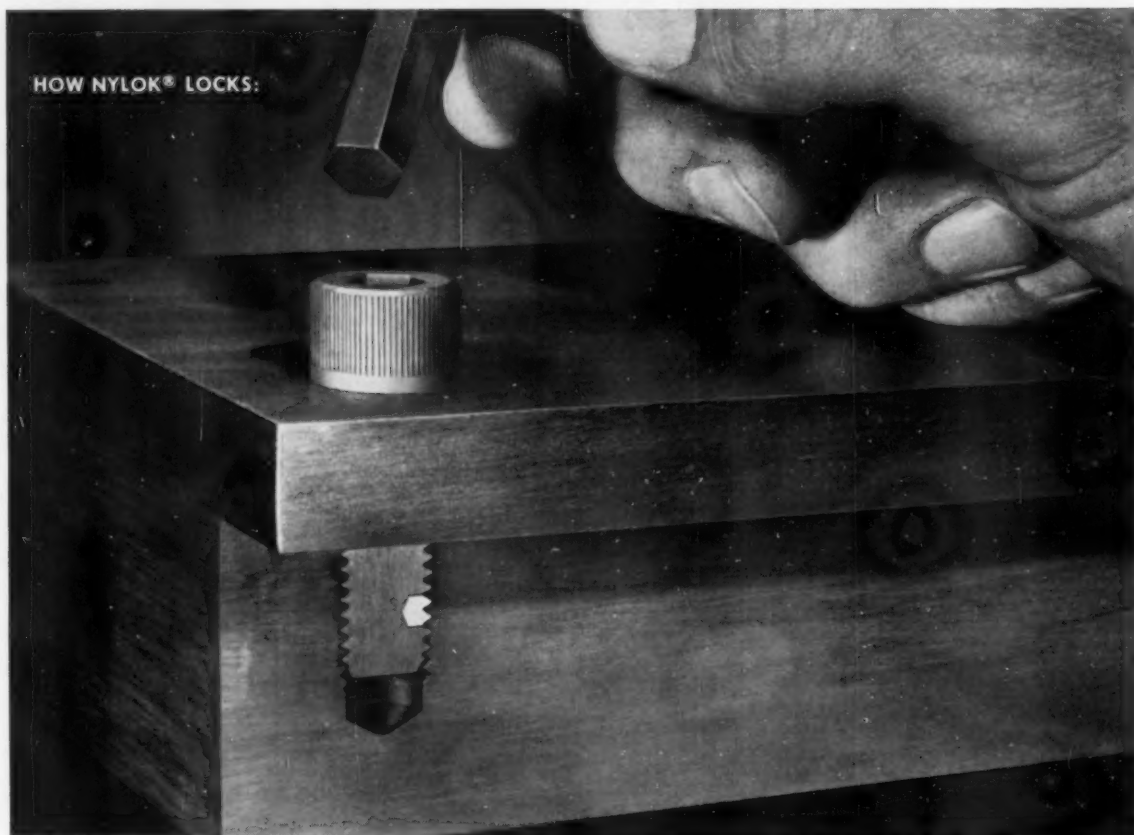
TE-8

R and L TOOLS

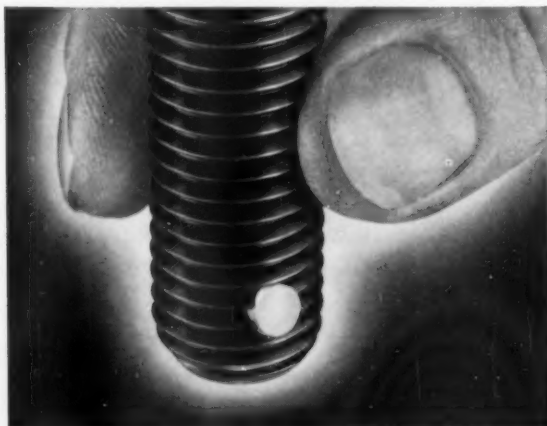
1825 BRISTOL STREET • PHILADELPHIA 40, PA.

TURNING TOOL • CARBIDE OR ROLLER BACKRESTS • RELEASING OR NON-
RELEASING TAP AND DIE HOLDERS • RELEASING DIE HOLDER FOR ACORN DIES
• UNIVERSAL TOOL POST • CUT-OFF BLADE HOLDER • RECESSING TOOL •
REVOLVING STOCK STOP • FLOATING BORE HOLDER • KIMBLING TOOL

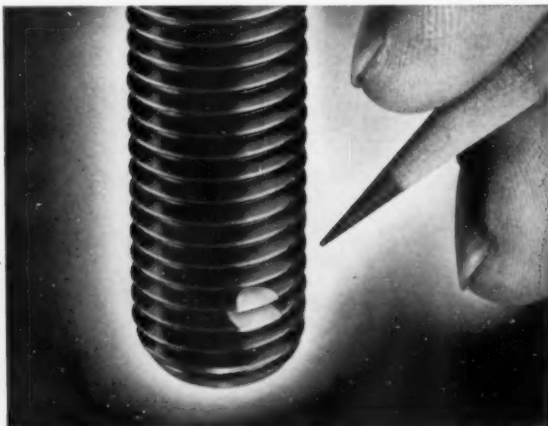
NEW—a complete line of socket screw products



LOCKED! The tough, resilient nylon pellet keys itself into the mating threads. It forces threads together, and locks the screw securely.



BEFORE ASSEMBLY. The nylon pellet projects slightly beyond male threads. When assembled, female threads will be impressed into it. Pellet locks effectively whether the screw is seated or not.



AFTER REMOVAL. "Plastic memory" of pellet has expanded impressed threads to greater diameter than screw threads. Screw can be used repeatedly. In use, "memory" keeps threads tightly locked.

self-locking UNBRAKO that won't work loose

**They simplify design and
save production time**

UNBRAKO socket screws are now available embodying the Nylok * self-locking principle. Nylok provides a truly practical new solution to the problem of making screws self-locking.

An UNBRAKO screw with Nylok is a single self-locking unit. No auxiliary locking devices are needed. Just thread the UNBRAKO into any tapped hole. *Seated or not*, it locks positively wherever wrenching stops. The tough, resilient nylon pellet forces mating threads together and holds tight. The screw will not shake loose.

You save production time when you build products with self-locking UNBRAKOS. And you get greater simplicity in design with less bulk and weight. The number of parts you must assemble to achieve full locking action is reduced to the absolute minimum. Lock-washers under screw heads are no longer necessary. Costly wiring of cross drilled heads is eliminated. So are cotter pins and complex multiple set screw installations.

Self-locking UNBRAKOS are completely reusable. They have uniform locking and installation torques—with no galling or seizing on mating threads. They successfully withstand temperatures from -70° to 250° F. And, on properly seated screws, the pellet acts as a liquid seal.

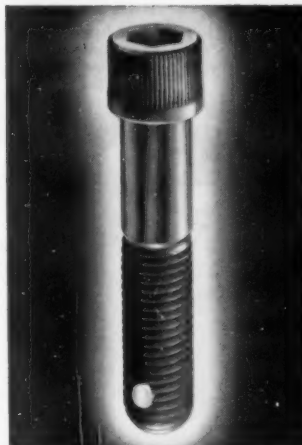
Self-locking UNBRAKO socket screws come in a complete range of standard sizes and materials. See your authorized industrial distributor. Technical data and specifications are detailed in Bulletin 2193. Write us for your copy today. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 37, Pa.

*T.M. Reg. U.S. Pat. Off., The Nylok Corporation

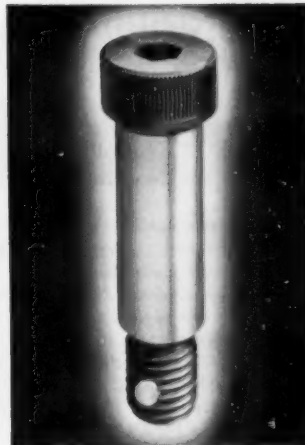
UNBRAKO SOCKET SCREW DIVISION

STANDARD PRESSED STEEL CO.

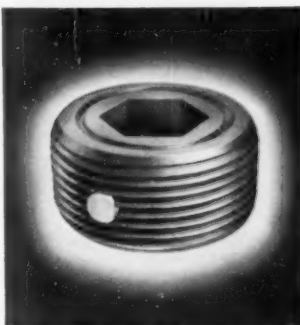
SPS
JENKINTOWN PENNSYLVANIA



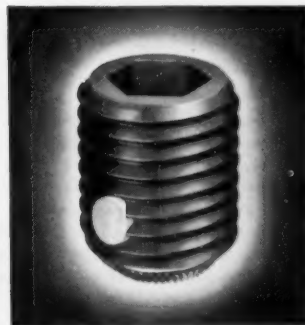
Socket head cap screws. Standard sizes # 6 to 1 in.



Socket shoulder screws. Standard sizes $\frac{1}{4}$ to $\frac{3}{4}$ in.



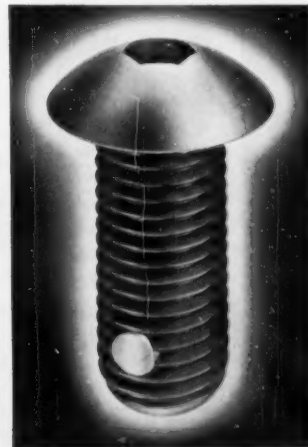
Socket pressure plugs. Standard sizes $\frac{1}{8}$ to $1\frac{1}{4}$ in.



Socket set screws. All standard point types. Standard sizes # 6 to 1 in.



Flat head socket screws. Standard sizes # 6 to $\frac{3}{4}$ in.



Button head socket screws. Standard sizes # 6 to $\frac{3}{4}$ in.

dixi 60

horizontal optical jig borer

with 5 optical microscopes

DESIGNED AND BUILT FOR:

VERSATILITY

Optical settings for operations in all planes and compound angles . . . Equally suitable for tooling, short-run or production work . . .

ACCURACY

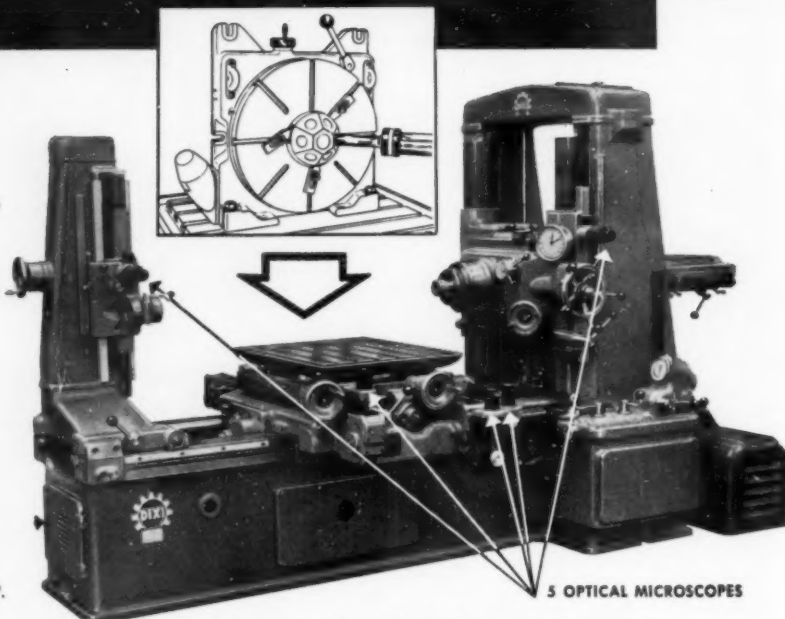
Overall accuracy of .0002"

A precision machine for JIGLESS boring, facing, milling, and drilling work, in all planes. Built-in 360° optical rotary table, 28 1/4" x 32 1/4". All spindle and table settings by optical microscopes. Infinitely variable hydraulic feeds. Mechanical spindle feeds with automatic depth stop. #40 taper spindle-speeds infinitely variable to 1400 R.P.M. Special features eliminate effect of spindle overhang on accuracy.

DIXI 450 PRECISION OPTICAL CIRCULAR DIVIDING TABLE

Direct readings of 1 sec.

(See insert picture above) rigidly mounted (not tilting) on built-in rotary table permits holding close tolerance relations between bores in all planes, including bores at compound angles. ALL IN ONE SET-UP. All sides of the work piece except the mounting face machined in one set-up.



5 OPTICAL MICROSCOPES

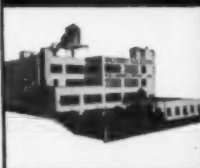
- Guaranteed service by factory trained staff
- Engineering staff available for consultation
- Spare Parts in New York stock
- Your operators trained

DIXI 60 now in wide use in leading Aircraft and Manufacturing Plants throughout the United States.

Names available upon request.

SEE THIS VERSATILE MACHINE IN OPERATION

at our New York or Cleveland Show Rooms. Write for Complete descriptive literature and prices to Department 21. Catalogues on additional production equipment also available on request.



Our Headquarters in New York City

M.B.I. export & import Ltd.

A Division of Machinery Builders, Inc.

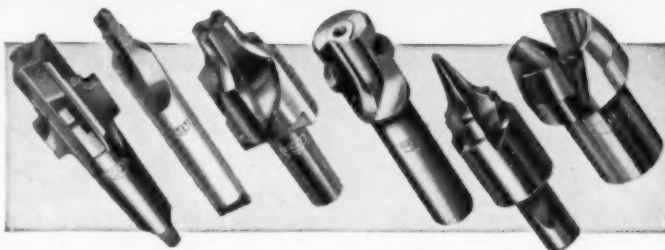
475 Grand Concourse, Bronx 51, N. Y.

"Over 20 years experience in designing & building machinery"

Phone: MOHt Haven 5-0900

Special Cutting Tools OF DEPENDABLE QUALITY

The Detroit Reamer & Tool Co. Plant is equipped with the finest in modern machinery and inspection facilities to provide you with the ultimate in precision tools. Our Engineering and production personnel with 35 years of empirical knowledge behind them are completely qualified to expertly handle your tool needs.



Grip-Tip (PATENTED) CENTERS with Replaceable Carbide Tips

CHECK THESE *Grip-Tip* FEATURES

- Long-Life Holders
- Replaceable Carbide Tips
- Easy Insertion and Removal of Male or Female Tips
- Reduced Machine Down-Time
- Lower Cost for Replacement of Carbide Tips
- Carbide Tips Accurate to .0003"
- No Regrinding of Holder
- Carbide Tips Are Easy and Inexpensive to Stock
- Reduced Regrinding Time
- Longer Diamond Wheel Life



Grip-Tip Centers are designed to substantially reduce your replacement costs and machine downtime for regrinding or replacement of worn or chipped centers.

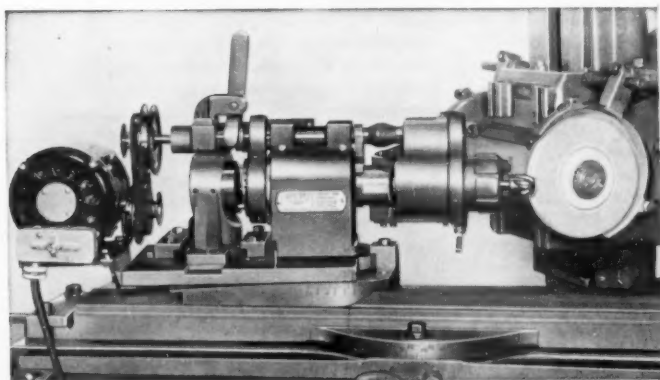
Male or female tips are inserted or removed from tool steel holders by simply turning clamping screw . . . you save replacement time.

The life of Grip-Tip holders is practically unlimited . . . only the tips are reground. Also, double end tips are relatively inexpensive . . . they reduce tool and inventory costs.

*It takes but a minute to remove and replace tips
... machine tool downtime is less with Grip-Tip.*

CIRCULARITY GRINDING ATTACHMENT

(Patented)



Circularity-Grinding Attachment illustrated permits your own tool makers to quickly and easily answer your production requirements for new cutting tools. With this attachment, new cutting tools can be quickly cut from raw stock, old tools converted to meet new requirements or standard tools reground to your specifications. The Circularity Grinder is of inestimable value when emergencies exist, demand for a new tool is urgent or production lines must be kept running. With this attachment in your shop you eliminate delayed deliveries.

DETROIT REAMER & TOOL CO.

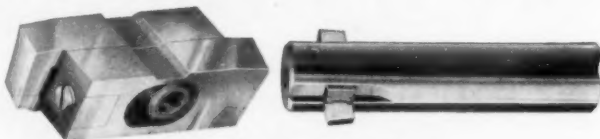
780 WEST MAPLE ROAD • P.O. BOX 174 • BIRMINGHAM, MICHIGAN





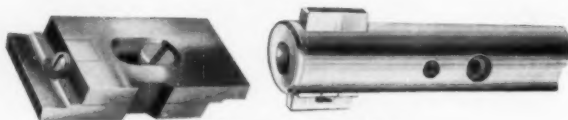
Madison Men cover every phase of Inner Diameters

BORING. For rough boring, MADISON Roughing Bars are available in sizes to properly handle the complete range of MADISON Rough Boring Cutters. Only MADISON features Free Cutting Action and One-Screw Adjustment.



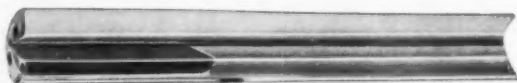
for Diameters 1" and up

REAMING. For finishing a hole to size with close tolerance and good finish, use the MADISON Reaming Tool. The MADISON features of Interchangeability, Adjustability and Controlled Float are inherent in every MADISON Tool.



for Diameters $\frac{5}{8}$ " and up

DEEP HOLE DRILLING. For producing truer, more accurate, finer finished holes, in one operation from the solid through gun-drilling techniques, use MADISON Deep Hole Drilling Tools. Unexcelled for both deep and shallow drilling applications.



for Diameters $\frac{5}{32}$ " to 2"

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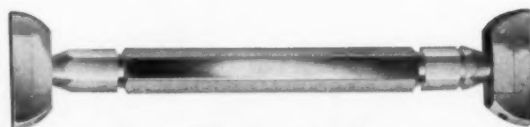
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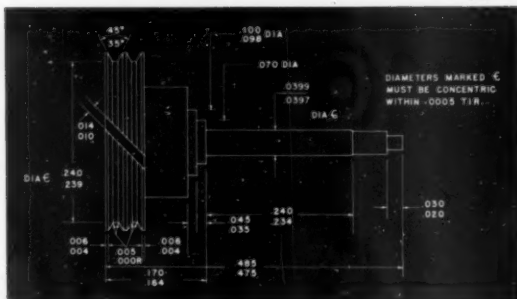
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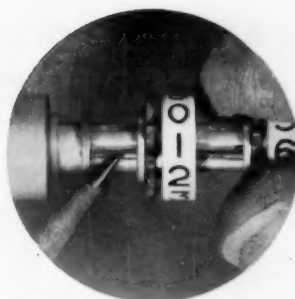
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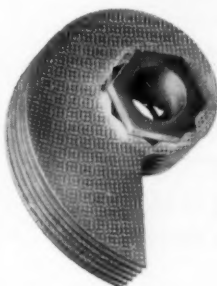
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Inspection of incoming precision shafts took 10 to 15 minutes each by mechanical gaging—involved concentricity, diameters, shoulder locations, and other tough-to-measure dimensions to tolerances of .0002". Doing the work on a Kodak Contour Projector cut time to 2 to 3 minutes per shaft.



The problem was to check many small calculating machine parts averaging about 13 critical dimensions for each with shapes mostly complex. With carefully engineered mechanical gages, inspection time averaged 50 seconds each. Optical gaging on a Kodak Contour Projector brought the average down to 12 seconds.



Spacing the parallelism of a special tuning condenser for electronic test equipment had to be held to very close tolerances. "Use of the Kodak Contour Projector," the company reports, "permits economical measurements of parallelism to an accuracy impossible to obtain by other methods."



On a flexible rubber-like part, rejects ran as high as 30%. By using a Kodak Contour Projector to measure the parts and then plotting results by statistical quality control methods, production changes were made that resulted in rejects dropping from 30% to less than 1/4 of 1%. Optical gaging eliminated distortion of the part while gaging, and proved 4 to 5 times faster than usual methods.

One instrument inspects these varied parts

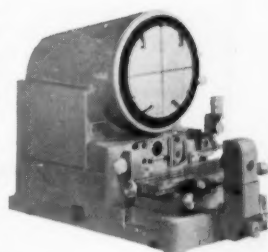
Here is another economy optical gaging can provide: switching from one part to a second part requires only a change of chart and fixture. You still use the same basic instrument. And with a Kodak Contour Projector, the variety of parts you can check is almost without limit. Here's why:

1. *Capacity*—Screen size on an optical comparator does not restrict the size of parts you can handle, for multiple-position fixtures allow the handling of parts larger than the screen itself. What's important is the staging area—and Kodak's unique relay lens provides uniform ample clearance regardless of magnification. The distortion-free image lets you measure anywhere on the viewing screen. The choice of lenses, of horizontal or vertical projection, and of surface or shadow illumination gives you the greatest possible flexibility.
2. *Ease of operation*—Kodak Contour

Projectors are designed for maximum speed and minimum operator training. The bright screen image reduces fatigue, lets you use the instrument in normal room light. Images are erect and unreversed at all magnifications. Finger-tip controls are within convenient reach of the operator.

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Whether you are now using optical gaging or just considering it, you should have a copy of the booklet, "Optical Gaging with Kodak Contour Projectors." It gives complete details on Kodak optical gaging equipment and how it can work for you. Write to Special Products Sales Division.



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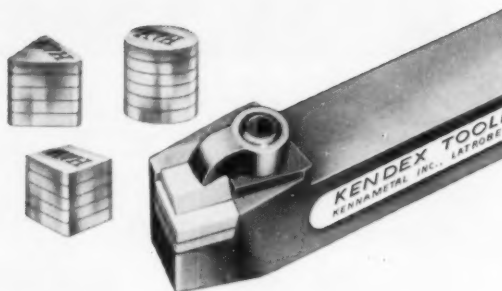
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Use Kendex Tooling with turn-over inserts (available in 17 styles and over 200 tools)... for lowest cost per cutting edge.

1

"Hard-to-machine" steel part finish bored 4 times faster with better dimensional control and better finish

OPERATION: Machine component of forged high nickel-chromium-tungsten content finish bored on a 62" King Boring Mill to size 38" diameter by 23 1/4" long, with a .014" feed and 3/16" depth of cut.

OLD TOOLING—Results: A special brazed shear tool with a competitive carbide, operating at 70 sfm, became very dull and produced only a fair finish with a slightly tapered bore.

WITH K7H—Results: A K7H cutting insert on a Kendex KSBL Holder, operating at 300 sfm (four times faster than with the previous competitive carbide), showed very little wear and provided an excellent finish with a straight bore.

2

Plunge and rough cutting heat-treated steel

OPERATION: Plunge and rough turning a heat-treated 1045 steel cylindrical machine part, operating at 350 sfm, with a .024" feed and 3/16" to 1/4" depth of cut.

OLD TOOLING—Results: Carbides previously used produced only 30 to 35 pieces per cutting edge.

WITH K7H—Results: A K7H throw-away type insert in a Kendex tool produced 110 pieces per cutting edge, with much lower tip and holder mortality.

3

K7H produced 8 to 12 times more pieces at twice the speed

OPERATION: A machine tool manufacturer ran this operation on 280 Brinell Hy-ten B-3X steel, with a .021" feed and 1/4" depth of cut.

OLD TOOLING—Results: Brazed tools using a competitive grade of carbide, operating at 210 sfm, cut only 2 to 3 pieces per grind.

WITH K7H—Results: K7H inserts on a Kendex Holder, averaged 25 pieces per cutting edge operating at 500 sfm.

The above results are typical performances of Kennametal Grade K7H on job after job. K7H has phenomenal strength (three times that of nonmetallics—even at high temperatures), top resistance to shock plus unusual resistance to wear and cratering. Try it on your hard-to-machine and high velocity jobs. A Kennametal tool engineer will be glad to assist you. Why not call him or write KENNAMETAL INC., Latrobe, Pa.

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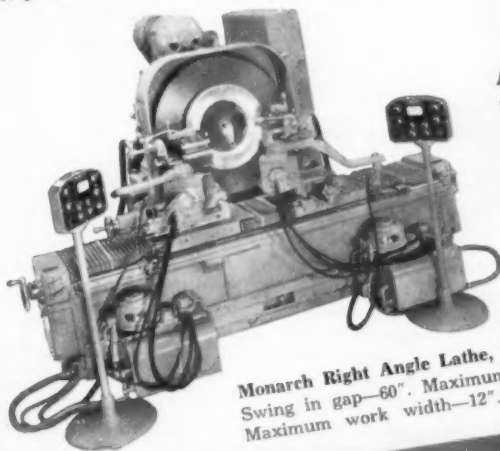
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... for the turning, boring, and facing of thin-walled work pieces having large diameter and short length.

Here's a specialized chucking machine for optimum output—for every plant producing this type of work in sufficient volume.

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Monarch Right Angle Lathe, Model O.
Swing in gap—60". Maximum turn diameter—48".
Maximum work width—12". Motor size—20 H.P.

All the features and uses of this machine would fill a book. They do, and we have it. Just ask for Booklet #1401
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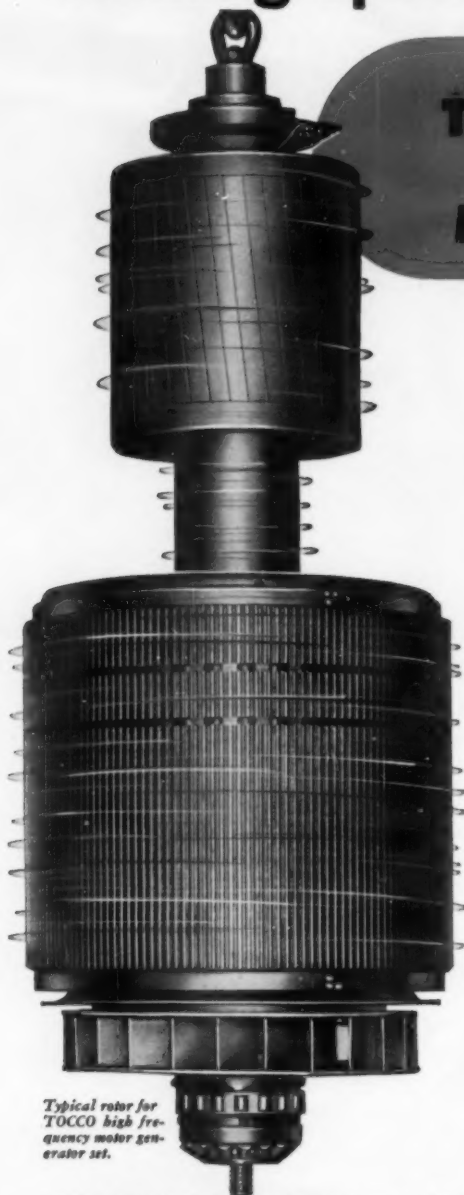
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The Tool Engineer

Can He Be an Engineer?

School begins again next month and your children may ask advice on courses of study and lifetime careers. Can your child successfully choose an engineering career? This question must be answered before it is too late.

Much has been written and said about the current need for more and better trained engineers. Engineering is now an attractive career. However, if your child is not prepared to pursue a rigorous technical course—through inability, lack of interest or inadequate secondary school preparation—heartbreak and waste may be the result.

Until they are about to graduate from high school, most children have only vague ideas of what they want to be. Then it is too late to point toward engineering. This means that your child should make a decision before he is mature enough to thoroughly consider it. He needs help.

We have engineered drudgery out of daily living—automation, electronic calculators, electrical appliances—but to an ill-prepared student, study is drudgery. Our children know that education is work; we must convince them it is worthwhile work.

Encourage your child to take "hard" rather than "snap" courses. A passing grade in a hard course is an accomplishment; a good grade in a snap course is meaningless. If your child shows an interest in things technical, he should take all the mathematics and science he can get. Good technical ideas are valueless if they cannot be communicated, so include English, speech and the humanities on the preferred list.

You cannot ignore your child's school either. Make sure it is capable of giving pre-engineering training. Work with the school. You can get help. Your local ASTE education committee, backed up by the National Education Committee can give you literature and assistance. Any college giving an engineering degree will be happy to consult with you, your child or both.

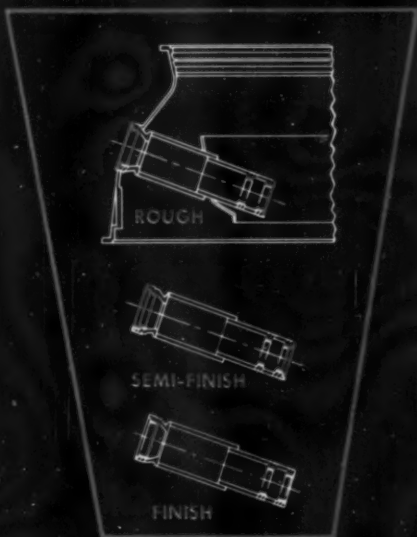
You know the satisfaction and rewards that an engineering career offer—the fun of creative work, the knowledge that you have contributed to our way of life. With a good secondary school background, your child can choose any career he wants; he might just choose engineering!

H.C. McMillen
President



Precision Bores and Faces Diffuser Cases

Another Special by Cross



This Two-Way Boring Machine roughs, semi-finishes and finishes the accessory drive shaft hole of Jet Engine Diffuser Cases at the rate of $2\frac{1}{2}$ pieces per hour. The operator places the part in the work holding fixture and the rough boring cutters in the boring spindles, after which the rough boring is performed automatically. Next, the operator replaces the rough boring cutters with semi-finish boring cutters and the cycle is repeated for the semi-finish boring operation. Then, the finish boring operation is performed in a similar manner and the part is removed.

The cutters are supported in live precision bearing spindles, which are in turn supported by hardened and ground steel bushings adjacent to the work.

All cutters are pre-set for size and are quickly and easily changed for the different operations.

To provide maximum flexibility for future part design changes, the machine is built with Cross Modular "Building Block" Units.

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where and how to apply Systems of Automation

By Wayne H. Folger, Jr.
The Heald Machine Co.
Worcester, Mass.

An orderly arrangement of basic principles, this article is "must" reading for anyone trying to understand automation in metalworking. Engineers planning new installations will find this discussion extremely helpful. These principles were first presented at the 1956 Purdue Tool Engineers Conference and met with immediate acclaim.

WHILE THE TERM "AUTOMATION" has become a common byword in industry, it is confusing without clear definition. Actually this seems to have increased rather than limited its use. At various times, the label has been associated with practically every form of automaticity. One conclusion is certain. Automation means different things to each one. To resolve this confusion, the first step is to find those concepts that everyone can agree on.

In some areas of production, automatic methods were quite highly developed before the advent of this so-called "automation era." Logically, this occurred where production quantities were large, where there was little year-to-year change in the product and where processes were generally less

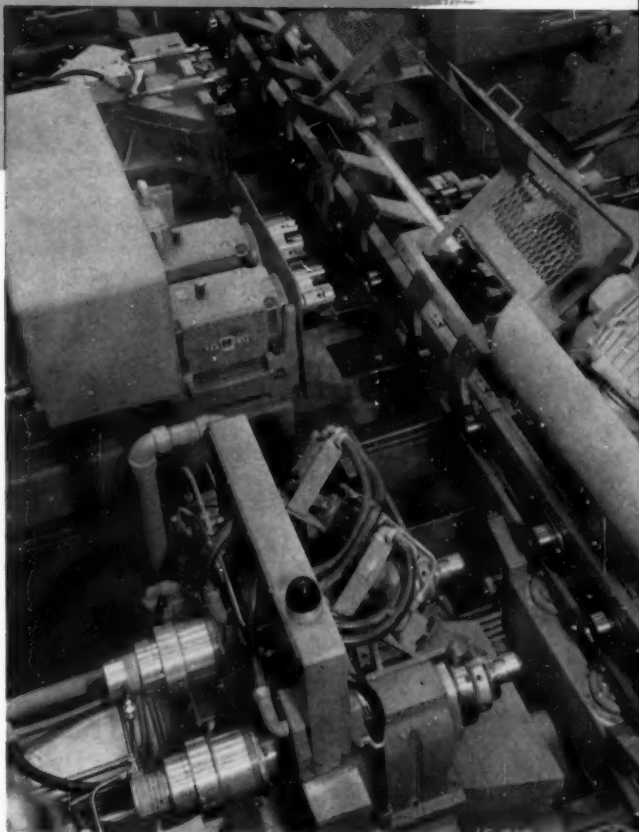


Fig. 1. Typical machine tool automation. Part is drum and sleeve assembly of cast iron. Operations are drilling, boring turning, facing, grooving and chamfering, with conventional bar type transfer.

complex than in the machining of metal products. Outstanding examples are the production of cigarettes, canned and bottled goods, staple foods, petroleum products and electric light bulbs.

Of most concern is this discussion in the accelerated development of automated machine tools, Fig 1. In this field automation is scarcely new,

Favorable Factors

- Floor space economy
- Single clamping and locating
- Fixtures return to starting position

Unfavorable Factors

- Balancing operations
- Size and number of stations limited
- Restricted approach to workpiece
- Vibration influence between stations
- Tool changes idle entire machine
- Autoloading restrictions
- Continuous chip removal problems
- After-gaging and feedback limited
- Coolant application and guarding problems
- Power clamping difficulties

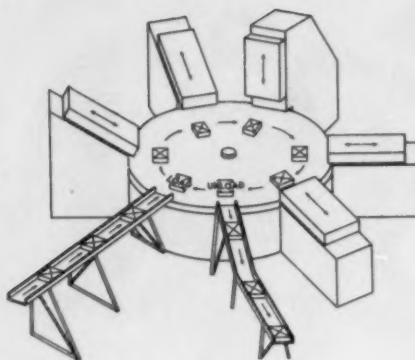


Fig. 2. Circular index automation

as the trend, at least, was well established before World War II. For example, there were internal grinding machines with completely automatic cycles and with automatic chute loading. With relatively few exceptions, however, the potential was unrealized until postwar economics provided exactly the right growth conditions. The highest volume production of mechanical goods in history, paired with increasing labor costs, has made it desirable to invest in automated machines.

It is a good bet that this trend will continue. Consequently, there is a need to learn everything possible about machine tool automation. A practical and simple approach is proposed—an evaluation of systems of machine tool automation now in use. The balance of this discussion centers on an analysis of those factors which make machine tool automation successful.

Most of these factors are already well known, but simply need to be related to each other and organized. Thus machine tool automation can be classified as four principal types:

1. Circular index automation
2. In-line index automation
3. Constant travel automation
4. Unitized automation

To stimulate thinking along these lines, the next step is to have a look at each of these and try to evaluate them.

Circular Index Automation

In this system the workpiece is moved intermittently from one working station to another in a circular path. The accompanying sketch, Fig. 2, depicts one such arrangement. Others are possible, such as indexing the work in a vertical plane.

One of the favorable factors in this system is

economy of floor space. Compactness is an inherent feature of this design. Another is the advantage of locating and clamping the part only once. Of course, all these factors must be appraised in relation to a particular application. They have different values and different effects depending on the actual work and operation performed.

For example, if the operations include roughing a casting and in the process strains are set up in the part, it would be detrimental to keep the part clamped through later finishing operations. Normally, however, there are definite advantages in avoiding relocating and reclamping a workpiece. Yet none of these factors are absolute.

Another normally favorable factor is that the holding fixtures always return to the starting position. For this reason this machine has frequently been used in limited forms of automation where the loading and unloading are performed manually.

A less favorable factor is the importance of balancing operation times between stations. The production rate with a machine of this type is established as the time of the longest operation plus the time for indexing. Hence it is necessary to plan operations carefully to avoid having one long machining time limit the over-all production rate. This arrangement also imposes definite limitations on the size and number of machining stations. This restriction arises primarily from practical size limitations of the indexing table. On this type of machine the approach of tools to the workpiece is restricted. It is easier to feed tools from the outside or from the top, more difficult to work from the inside out, from the bottom or from the two ends.

Moreover, there is the possibility of vibration being transmitted between stations, thus affecting finish and tool life. Intermittent roughing cuts may make it impractical to include precise finishing

operations. It is also significant that tool changes idle the entire machine, thereby influencing operating efficiency. Automatic loading and unloading is somewhat restricted.

Continuous chip removal requires careful planning and there are fewer ways to accomplish this on a rotary indexing machine than in some of the other forms of automation. After-gaging and feedback are seldom employed because of space and other limitations.

Coolant application and guarding may be more difficult. Coolant has to be supplied from stationary points over and around the work unless specially designed manifold arrangements are provided. Likewise, power clamping requires special consideration as rotating glands are needed to bring oil or air to the fixtures. For this reason spring clamping may be required with special provisions for releasing the pressure during loading and unloading.

In-Line Index Automation

This is a system of intermittently moving the work from one station to another in a straight line, Fig. 3. This is commonly referred to as the transfer machine and has been widely used. It is often favored because it facilitates the general flow of work through the plant and comes close to many concepts of full automation.

In-line automation permits considerable flexibility in number and type of stations. Floor space and operating efficiency become the principal limiting factors but much more freedom is permitted than on the rotary index machine. An instance is the opportunity to reorient the part. With proper equipment the work can be shifted to different positions.

This means fewer restrictions on the approach to the workpiece.

Continuous chip removal is relatively easy to incorporate in the system as chips can be dropped into straight line chutes and conveyors of many types. The effect of vibration between stations is slight due to the normal separation of the working stations. The in-line transfer machine is also easy to load and unload by automatic means or it can readily be adapted to manual handling at the beginning or at the end of the line. Heat and distortion effects are greatly minimized due to unclamping as well as the time interval between operations.

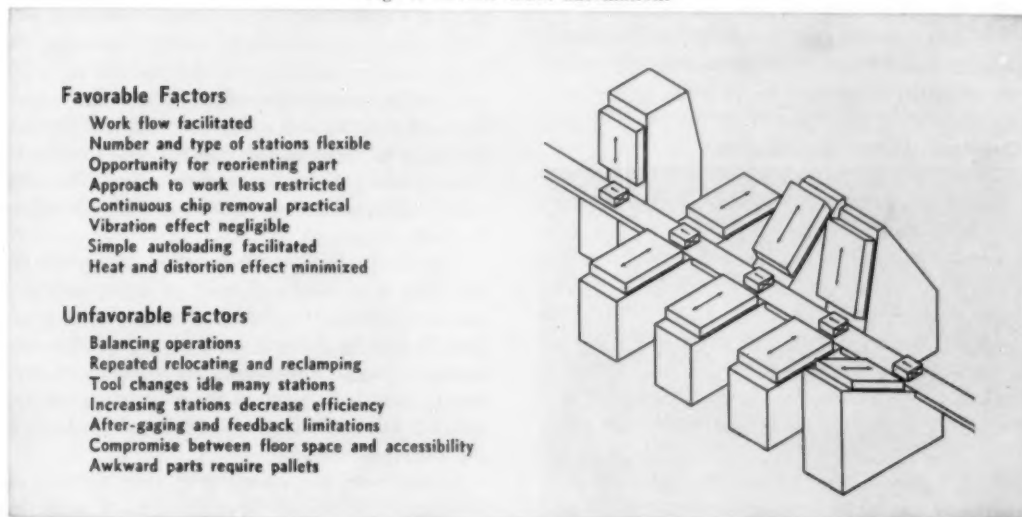
Again, a less favorable factor is the necessity of balancing production time between stations to arrive at a suitable cycle time. This frequently means that operations, such as the drilling of long holes must be divided between stations.

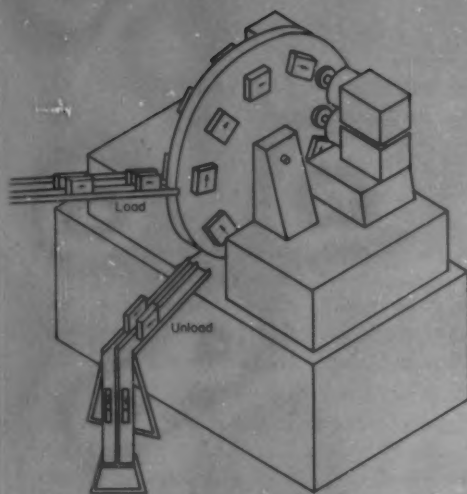
Parts, and pallets if employed, have to be re-located and reclamped repeatedly at each successive station. This necessitates special planning to provide fixtures that will maintain the required accuracy between surfaces machined at different stations.

Tool changes will idle many stations. This is an important consideration since over-all operating efficiency drops as the number of stations increases. This may require planning the machine in sections, with independent transfer mechanisms and banking facilities between the sections. After-gaging and feedback may be limited because extra stations in the line are usually required for this type of equipment.

In-line transfer machines are not particularly economical in the use of floor space. In addition accessibility must be provided between units for

Fig. 3. In-line index automation.





Favorable Factors

Single clamping and locating
Identical simultaneous operations

Unfavorable Factors

Type of operation restricted
Workpiece variety limited
Automatic gaging and feedback curtailed
Tool changes stop work flow
Autoloading "On the Fly"

Fig. 4. Constant travel automation.

tool changes and maintenance. Certain part designs do not lend themselves to transferring unless placed on separate fixture pallets. Pallets must be viewed as a necessary evil, since they add extra expense, both initially and as a matter of maintenance. Besides, they complicate the transfer mechanism due to the fact that they must be returned to the starting position. Some form of manual loading and unloading is usually required when they are employed.

Constant Travel Automation

This is a system that has been infrequently used in machine tool automation but has a place in a general discussion of this nature. In this arrangement, Fig. 4, the workpiece moves continuously, either in a straight line or in a circular path. It naturally associates itself with operations like milling and broaching but sometimes is used for other operations by the design of special types of machines which move the tools together with the workpiece.

In this system, locating and clamping are done only once. In typical applications, Fig. 5, it has been

possible to handle more than one part through the machine, so that duplicate operations are performed simultaneously. The sketch, Fig. 4, similarly shows work being machined on both sides of a revolving carrier.

Less favorable factors in the use of this system include restrictions on the type of operations performed, the limited variety of parts to which it can be adapted, severely curtailed use of automatic gaging and feedback, work flow stoppage by tool replacement, and the fact that automatic loading and unloading must be accomplished "on the fly."

Unitized Automation

This is a term coined to describe automation of separate independent machine units through which the work is moved by means of special handling equipment such as chutes, conveyors and elevators.

In the sketch, Fig. 6, is one arrangement of this system. Work starts at one end of the main conveyor and flows along to the take-off chutes which supply parts to the machine units. The work is processed automatically through these independent machines, and then brought back to the conveyor by means of elevators. One group of machines does the first operation, another group does the second operation, etc.

There are a number of favorable factors influencing the use of this unitized system of automation. First, it provides truly continuous work flow, as the individual units are releasing work to the main conveyor at different times and the conveyor itself is moving the work along at all times. Complete freedom exists in planning the number of stations required.

Opportunities to reorient the part are practically unlimited, as these can be varied from machine to machine. Consequently the approach to the workpiece is unrestricted. There is full freedom in providing for continuous chip removal and again the method can be varied to suit each operation.

There is no vibration effect between units since they are separate and completely isolated. The machine units used in this system can readily be designed for auto-loading and unloading. The most suitable type of loading can be used for each unit in the line.

Use of separate machines makes for easier application of a variety of machine types, including standard models. If suitable units are already available, it may be possible to fit them into this new system. Several outstanding applications of this system have been made in the antifriction bearing industry using relatively standard models of grinding machines.

Furthermore, this arrangement gives the user an opportunity to employ specialized units made by

Considerations for Practical Automation

- | | |
|--|---|
| 1. Suitable production quantities | 8. Continuous chip removal |
| 2. Coordinated part design | 9. Clearing chips from part |
| A. Favorable machining characteristics | 10. After-gaging, feedback & auto sorting |
| B. Orienting, locating & transferring surfaces | 11. Banking of workpieces |
| C. Stability of design | 12. Centralized controls |
| 3. Adequate tool, cutter & wheel life | 13. Auxiliary setup controls |
| A. Counters & controls | 14. Quick tool adjustment & replacement |
| 4. Preinspection | 15. Maintenance & accessibility |
| 5. Clean work locating surfaces | 16. Trouble-free components |
| 6. Safety interlocking | 17. Centralized automatic lubrication |
| 7. Complete foolproofing | 18. Change-over flexibility |

different manufacturers, thus taking full advantage of their particular abilities. After-gaging and feedback can be fully utilized to increase efficiency and improve quality by making corrections in successive cycles.

Banking of parts between operations is provided automatically and allows one group of machine units to continue functioning even though machines on prior operations are stopped temporarily. For the same reasons, tool changes idle a single unit only.

This system is capable of the highest over-all operating efficiency. Required rates of production can be sustained by using the proper number of units at each operation to overcome the normal production losses through wheel and tool changes, adjustments and maintenance.

Looking at it in another way, it is entirely possible to operate this system efficiently at production rates below the normal maximum. In this case, a portion of the units performing each operation can be made inoperative and the remaining units allowed to perform normally. This is the only system that allows such flexibility in adding or removing operations, increasing production, or accommodating part changes.

For many applications there is remarkable economy in this unitized system because just the right number of units for each operation can be provided. To clarify, suppose the arrangement shown is being used to manufacture automotive pistons in a large Detroit plant. Plans call for approximately 1200 pistons per hour. Some of the faster operations are performed in approximately 8 seconds as compared to several finishing operations which require approximately 24 seconds. If this were an indexing system, it would take practically three times as many stations on the fast operations as it does with unitized automation.

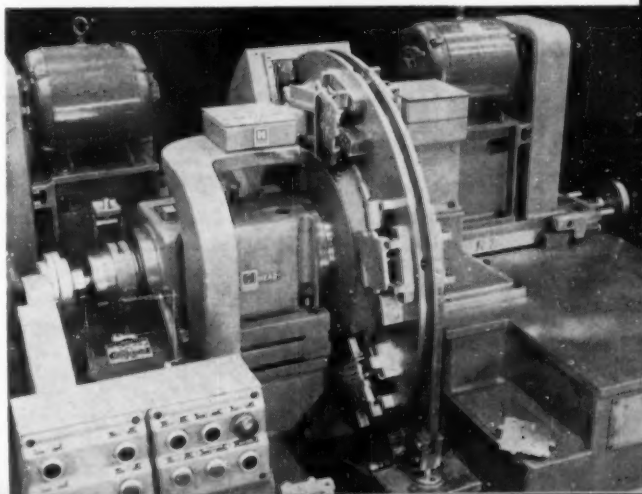
Fig. 5. Facing a valve body of aluminum to 20-microinch rms, finish on constant travel machine.

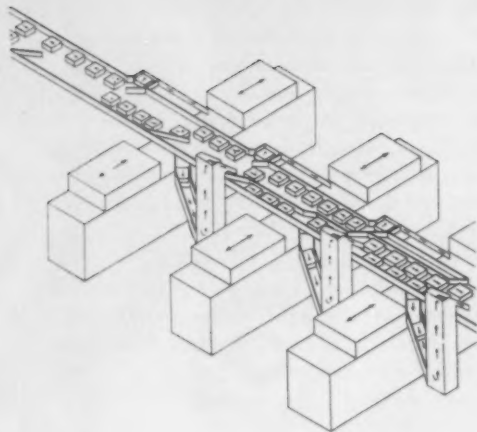
As with anything, considerations affecting use of this method are not all favorable, however. There are restrictions on the workpiece sizes and design. As an example, it might be rather inefficient to handle a large casting such as an automotive block by this system. In general, smaller parts create few problems and the ideal parts are round so they can be rolled through simple chutes.

Also to be considered is the problem of floor space requirements, since a number of independent units may not be as compact as some of the other systems. There is also the requirement of duplicating equipment for orienting, gaging and other functions if the part design and application require these.

From this evaluation of the common systems of automation, the next logical step is when and where to apply them. Some important considerations in making any form of machine tool automation practical are listed in the accompanying table. To successfully automate, production quantities must be sufficiently large to make a reasonably short term payoff on investment. This is the most practical starting point for automation in anyone's plant. At the present level of knowledge, engineering skill has yet to reach the stage to permit frequent change-overs and setups to accommodate a variety of sizes or styles of parts. For the time being it is best to stay on firmer ground and automate only major production items.

Automation prospers best when top management creates an atmosphere in which part designers, tool engineers, production people and sales personnel all work closely together to achieve coordinated part designs. Practical automation is difficult, if not impossible, if these functions are carried on independently. This means, in simple language, that parts must be designed with favorable machining characteristics and that it may be necessary to incorporate special surfaces for orienting, locating or transferring. It would also help to have some omniscient power decree that designs be stabilized be-





Favorable Factors

- Continuous work flow provided
- Number of stations unlimited
- Opportunity for reorienting part
- Approach to work unrestricted
- Continuous chip removal made easy
- No vibration effect between units
- Complete freedom in autoloading
- Existing machines may be adapted
- Different mfrs units readily incorporated
- After-gaging and feedback unlimited
- Parts banking provided
- Tool changes idle only single unit
- High over-all operating efficiency
- Efficient operation at different production rates
- Adaptability to change
- Economy in number of units

Unfavorable Factors

- Workpiece size and design restricted
- Floor space may be large
- Equipment elements duplicated

Fig. 6. Unitized automation setup.

fore automation is attempted.

Practical automation also presupposes that tooling methods have been solved to the point that there will be adequate tool, cutter and wheel life. In cases where tooling experience is satisfactory, equipping the machine with special counters and controls encourages or compels proper tool changes.

Automated machines do only what is designed into them; never more, sometimes less. It is essential to guard against many undesirable possibilities by preinspection methods such as probing or gaging; work locating surfaces must be kept clean; machine functions must be interlocked and correct sequence of operation insured; foolproofing is desirable.

The human element is still important in automation. There is not only the problem of protecting the machine and work from careless and unpredict-

able workers, but every machine must be made safe for all personnel in the area.

Another aspect should be considered. Operatorless machines must do a great many more things automatically than is ordinarily supposed. It is a common misconception that many of the familiar types of automatically cycled machines merely require an operator to load and unload. Careful analysis, however, quickly proves that he does many important incidental things, such as cleaning off chips, rough preinspection to prevent "smash-ups," and work orientation before loading. All these and other things must be carefully designed into the equipment when the operator is removed.

Conclusion

Few automated machines are practical without continuous chip removal. This includes the means of clearing chips from the parts, from toolholders, from fixtures and, in short, conveying them to points where they can be disposed of systematically. Equipment for after-gaging, feedback and automatic sorting is frequently essential, in one form or another, to successful automation.

Some thought ought to be given to banking parts, when automation is being planned. When omitted from the system, can banking be done manually in an emergency?

Automated machines need centralized controls for normal operation but, in addition, require auxiliary controls for setup, tool change and maintenance. These must include safety interlocking features to protect personnel.

Quick adjustment and change of tools, cutters and wheels need careful attention to minimize idle time and get the most from expensive equipment. Attention has been called, in discussing the several types of systems, to the effect these changes have in idling related equipment.

By the same token, both the machine designer and tool engineer need to plan for accessibility and maintenance. Many early efforts have slighted this critical factor but now it comes in for greater attention than it deserves. Allied closely with this is the consideration of centralized automatic lubrication and the selection of the best, trouble-free components. Pennies saved on initial investment are seldom pennies earned, in automation.

One last check point—every effort should be made to plan for as much change-over flexibility as possible. This admittedly is difficult, but any accomplishment may give rich returns when the inevitable product change comes through. This approach is summed up in a slogan that is particularly appropriate to this subject . . . "Tomorrows are planned today."

Electrochemical Marking

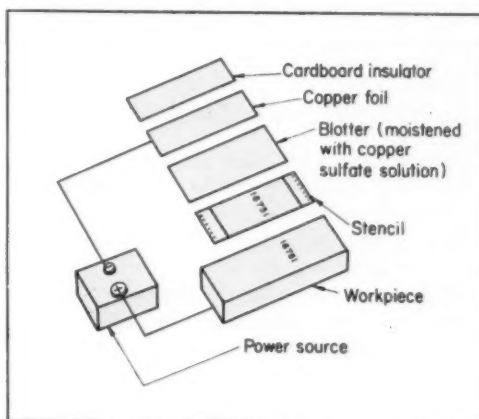
Tools, dies and gages can be marked with type-written identifications through the use of a simplified galvanic etching process. Cost of the process is low; it works equally well on hardened ferrous parts and nonferrous materials and an elaborate setup is unnecessary. Materials required are an ordinary mimeographic stencil, a sheet of blotting paper slightly smaller than the stencil, approximately six ounces of a saturated solution of copper sulphate, a piece of copper foil the size of the blotting paper, a sheet of cardboard somewhat larger than the stencil, and a six or twelve-volt d-c power source.

The desired marking is typed on the stencil exactly as for ordinary mimeographic duplicating. The surface to be marked is cleaned thoroughly and is then connected to the positive pole of the power source. The stencil is taped to the workpiece in the proper position for marking, and the blotter is then taped over the stencil. An eyedropper is used to moisten the blotter with the copper sulphate solution.

A wire is fastened to the sheet of copper foil which is placed over the blotter. The sheet of cardboard is placed on top of the copper foil to act as

an insulator and the entire "sandwich" is held together by a clamp or weight. Connecting the wire from the copper foil to the negative pole of the power source closes the circuit. Approximately ten minutes of etching is sufficient to engrave the type-written copy into the workpiece.

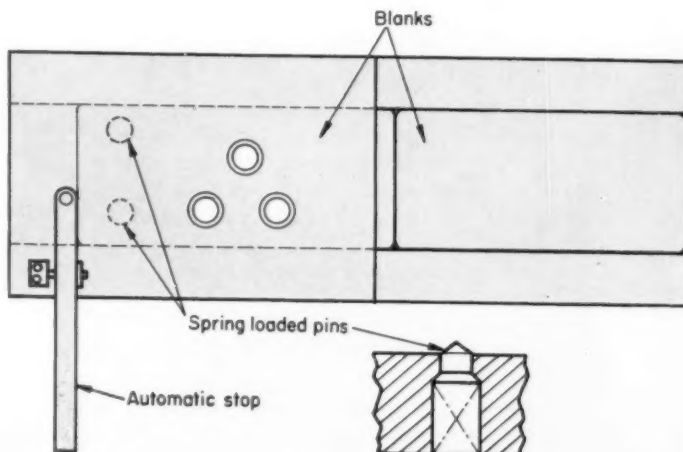
Max Samuely
Los Angeles Chapter

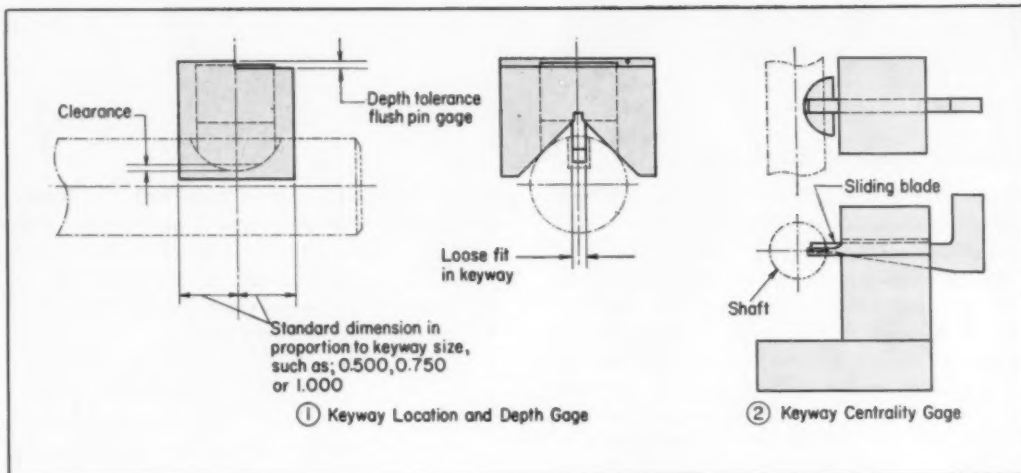


Blank Lifter

When one blank is used to push another through a piercing die, an automatic stop cannot ordinarily be used. The stop rides off the top of the completed blank and fails to catch the edge of the incoming blank. This difficulty can be eliminated through the use of two spring loaded pins to lift the incoming blank slightly as it approaches the stop, allowing the stop to catch the edge of the blank. The tops of the pins are chamfered so they do not interfere with feeding.

Henry Koslow
Bronx, N. Y.





Woodruff Keyway Gages

Close tolerances are often required in the machining of Woodruff keyways in small shafts. The two gages illustrated offer a low-cost solution to the problem of accurately gaging the location, depth and centrality of such keyways.

Depth can be determined by means of a flush pin mounted in a steel block which has been shaped as shown in Sketch 1. When the flush pin is held firmly in the bottom of the keyway, distance to a shoulder or the end of the shaft can be determined

by direct measurement from the end face of the gage.

Centrality of keyways can be determined through the use of a holding fixture, Sketch 2. The sliding blade acts as an adjustable parallel and holds the shaft firmly in the keyway. With the fixture on a surface plate an indicator reading is taken over the OD. The shaft is reversed and a second indicator reading is taken, giving a direct reading of the slot centrality with the OD.

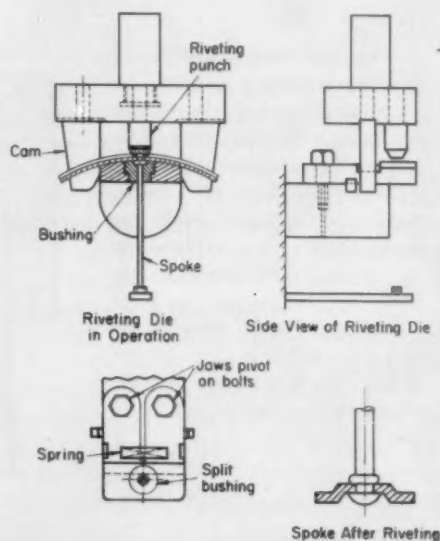
*W. R. Eldridge
Little Rhody Chapter*

Riveting Die

Riveting operations to fasten spokes to the rim of a wheel can be performed on a punch press through use of the die illustrated. This die consists of a standard riveting punch and a pair of gripping jaws containing a hardened steel bushing which is cut in half to allow the jaws to open. The top of the bushing is undercut to allow room for upsetting.

As the punch descends, the two jaws are forced together by hardened steel cams, gripping the spoke firmly for the riveting operation. The jaws are opened by a coil spring when the die is released from the cams on the upstroke of the press.

*Hjalmar Dahl
Upplands Vasby, Sweden*



Bending Jigs

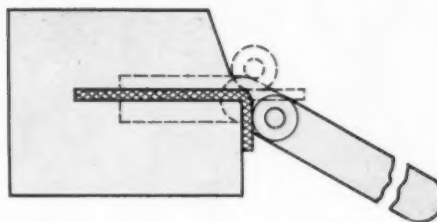
Customary methods for bending limited numbers of small metal stampings involve the use of press brakes with universal type tooling or bending dies mounted in mechanical presses. Bending jigs can also be used for such operations and have many advantages, particularly when workpieces are too small for handling in a press brake or mechanical press, when stamping shapes are irregular or when compound forming shapes are required. In addition, bending jigs are portable, eliminate the need for die setting, and their production rate equals or sometimes exceeds that obtained from conventional forming dies.

The simplest type of bending jig is shown in Sketch 1. It is used for square bending of a workpiece with legs of unequal length. An alternate design for making the same bend is shown in Sketch 2. Here the workpiece is bent directly by means of a slot in the bending spindle. Both designs are satisfactory because the center of rotation of the moving component coincides with the bend in the workpiece and there is no appreciable relative movement or friction between the workpiece and jig components.

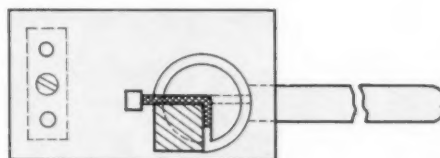
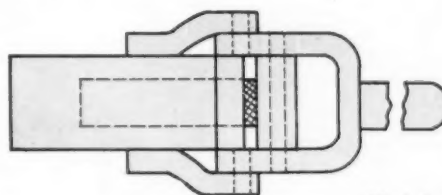
If such an arrangement is not possible, the arc of the moving component should be made to coincide as much as possible with the corresponding chord. This is illustrated by the multiple bending jig shown in Sketch 3.

The ability of jigs to form compound bends which are difficult or impossible to form with one press stroke on standard bending dies is illustrated by the jig shown in Sketch 4. With one movement of the handle three successive bends are effected in the workpiece: a bend with an angle smaller than 90 degrees, a curve and a second bend with an obtuse angle.

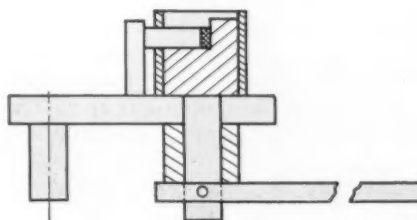
*Federico Strasser
Santiago de Chile*



Sketch 1

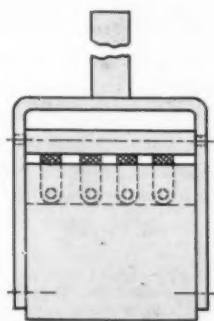
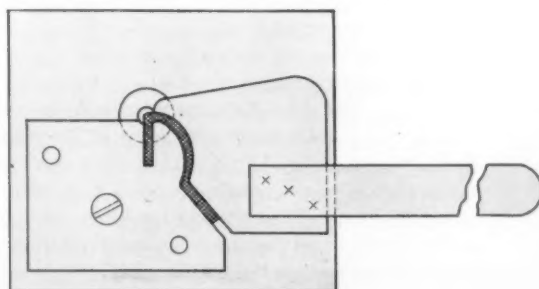


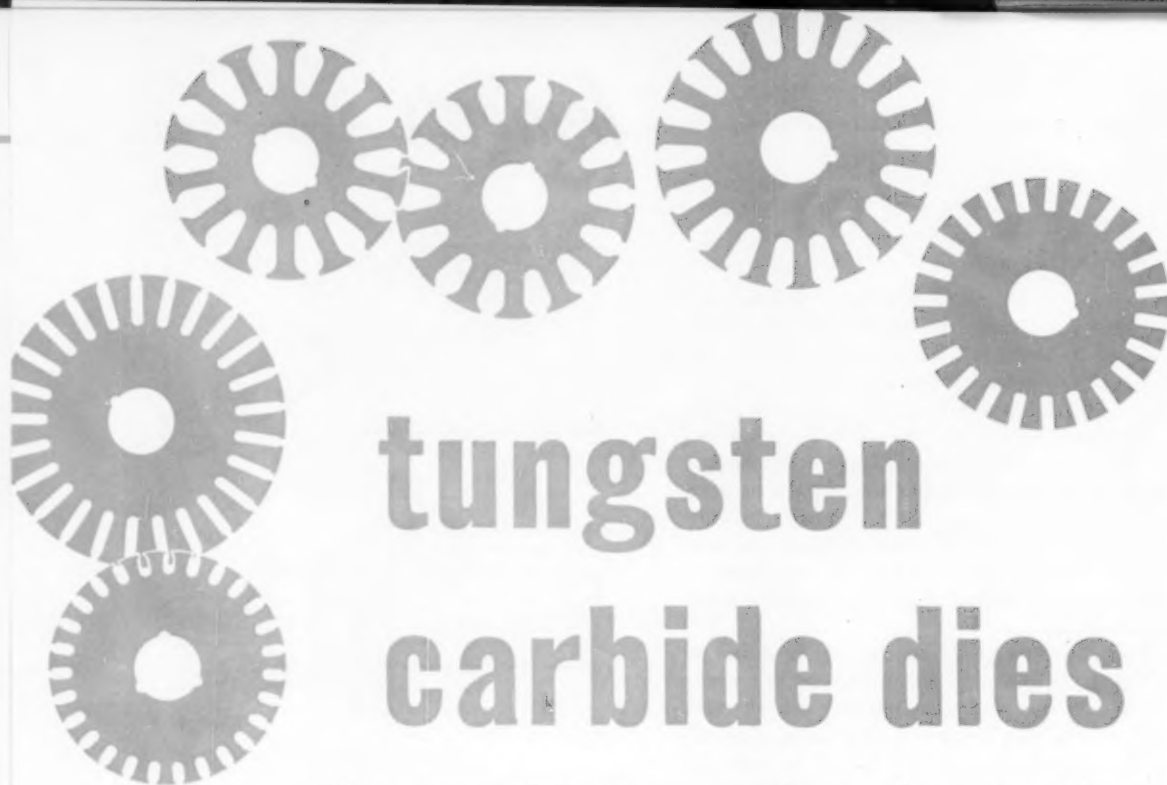
Sketch 2



Sketch 3

Sketch 4





tungsten carbide dies

for punching armature laminations

By W. A. Fletcher†

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Mechanization of manufacturing has destroyed the normal balance between material, labor and overhead costs but may not always save money. Improved tooling and increased service life do save money. Author Fletcher describes successful stamping of electrical components with carbide dies.

TUNGSTEN CARBIDE DIES can be designed as modifications of conventional steel dies. In addition to following basic die design principles, it is only necessary to take advantage of the good characteristics of the material and minimize its limitations. Because carbide has low resistance to bending stress, it should be adequately supported to prevent vibration and deflection. Carbides cannot be machined by conventional cutting tools so die parts must be designed for finishing by grinding. Intricate shapes or die blocks having more than one

hole, Fig. 1, present difficult grinding problems unless the design can be made of inserts or sections that can be ground.

A typical part made with carbide dies is the lamination used to build the core of generator and starting motor armatures. High-speed presses make between three and four million laminations per day and the dies have to withstand high impact and compressive forces. Runs of 200,000 pieces per grind were considered good with steel dies. About ten times this number can be produced per grind with tungsten carbide dies.

Armature laminations are made from hot-rolled steel strip, Fig. 2. First, the slots are punched and then the parts are blanked from the strip. There are 48 punches in the die.

One of the piercing stations is shown in Fig. 3. Carbide piercing punches are floated from the top shoe and guided by solid carbide stripper inserts to mate with carbide insert cutting parts. The pilot is made of carbide and is guided by a carbide bushing. Because the piercing punches float in the driver, slight misalignment does not affect guiding of the punches or clearance in the die section. Blanking punches are fastened rigidly to the top

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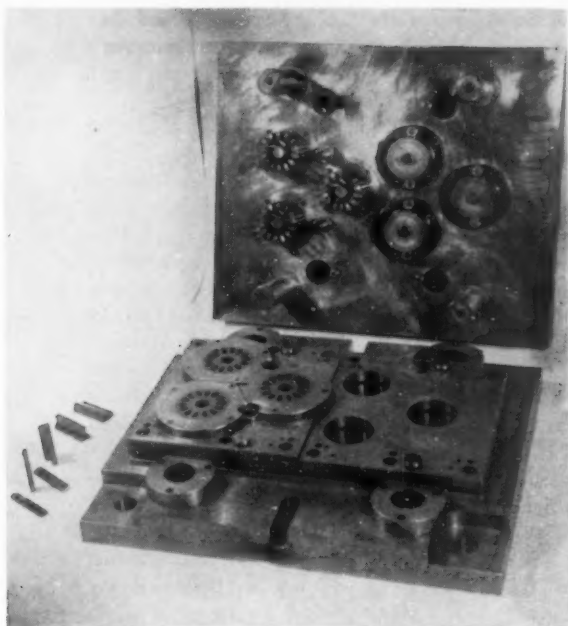
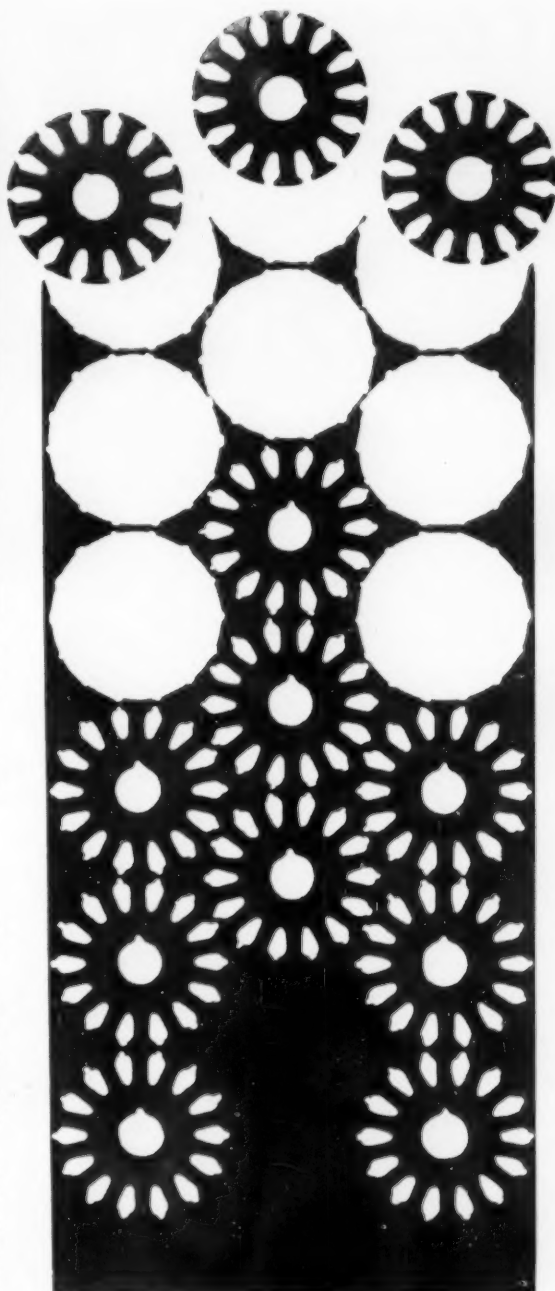


Fig. 1. Piercing and blanking die used to manufacture laminations for generator and motor armatures. Punches, punch guides in the stripper and die sections are made of solid tungsten carbide.

Fig. 2. (right) Hot-rolled steel strip is used for armature laminations. After the slots are punched, the parts are blanked from the strip.



shoe. Small punches were made with carbide tips brazed to steel shanks but the braze did not hold up and punches are now made of solid carbide.

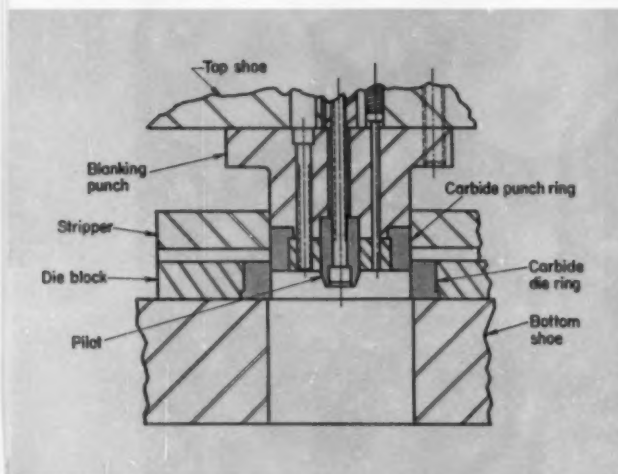
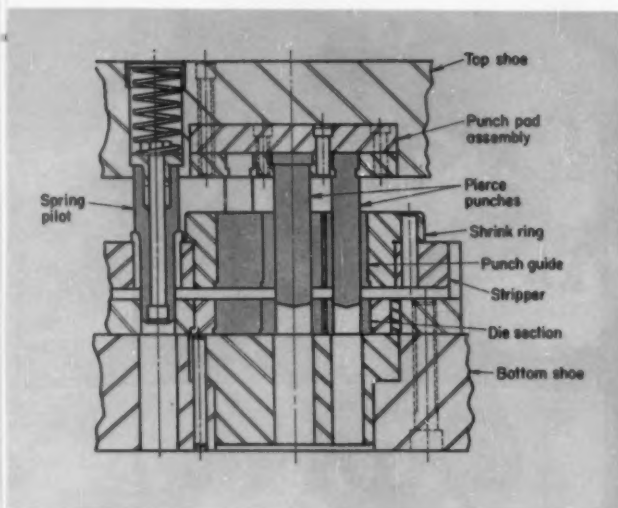
The die block is made of 14 carbide sections that are shrunk into a steel ring. These sections must be accurately ground because they form a perfect ring when assembled. The circular carbide insert in the center is the die for the shaft hole in the lamination.

At first, carbide was used for both the guide pin and its bushing. This proved impractical because slight misalignment could shatter both parts. A steel guide pin and a special bronze bushing are now used. Over long periods of time, this special bronze material grows. Such growth more than makes up for wear in the bushing and correct clearances are maintained by periodic grinding.

Construction of the blanking station is shown in Fig. 4. A carbide ring is mounted in the die block and a carbide punch ring is clamped on a tool steel blanking punch. The pilot is also made of carbide.

When proper clearance is incorporated in die design, fractures start at the top and bottom of the strip and progress until they meet. With insufficient clearance, the two fractures do not meet,

causing a double break. This condition shortens die life and makes parts with rough edges. Experience has shown that clearance should be from four to five thousandths on each side when working with $\frac{1}{16}$ -inch hot-rolled steel. With such clearances, however, some trouble is experienced in keeping the slugs down in the die. After three or four hours of operation with an initially sharp die, this trouble disappears. The same results can be



achieved by slightly dulling the punches and die with a diamond stone. A radius of about one thousandth is sufficient to make the slugs and blanks stay in the die.

Comparison of the methods for making piercing punches of steel and carbide is indicated by Fig. 5. To make the punch of steel, a slug such as the one at the left in the picture is used. It is turned to the rough diameter, leaving a center on each end. Heat treating and grinding are then done. For a carbide punch, the starting point is a slug of approximately the right shape. Centers are silver soldered on the ends of the slug and the grinding is performed. Although carbide cannot be ground quite as fast as steel, warpage is not a problem so the time lost during rough grinding of a carbide punch is gained back as finished dimensions are approached.

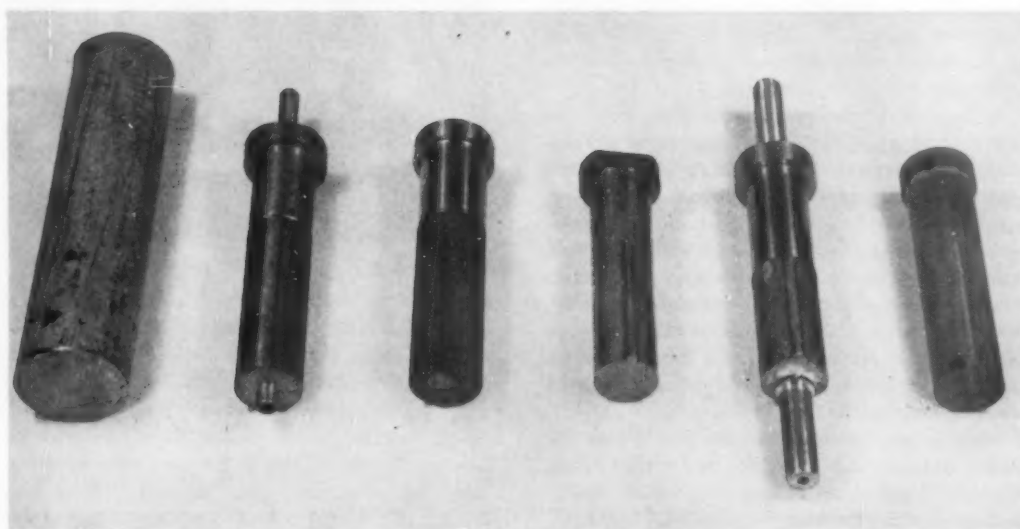
Piercing punches for lamination dies can be difficult to grind because of their intricate shapes, Fig. 6, and close tolerances. Through use of special fixtures and hand-operated grinders, Fig. 7, grinding is precise. Automatic feed is not used because it may introduce more vibration than hand control. Each machine has its own sine bar magnetic chuck and only one operator uses a specific machine. Adjustment of the grinders is simplified through use of an added vernier scale.

Chipped carbide dies can usually be resharpened simply by grinding three or four thousandths off the top surface. Chipping of the die occurs at the top

Fig. 3. (top) Section through a piercing station of the die in Fig. 1.

Fig. 4. (center) Section through a blanking station of the die in Fig. 1.

Fig. 5. (bottom) Steps in the manufacture of a steel piercing punch, left, and a carbide punch.



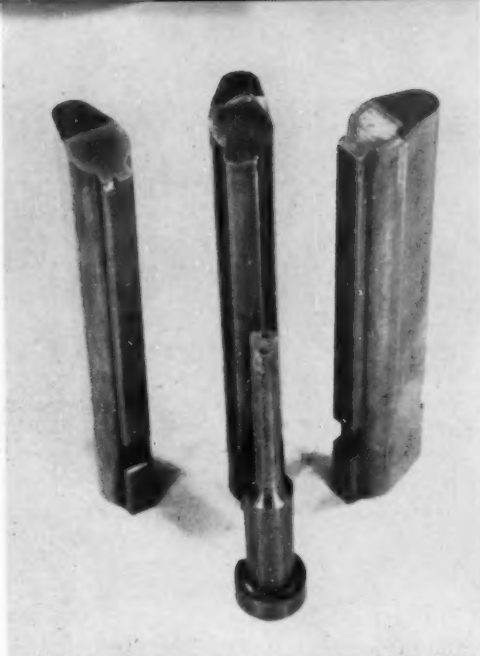


Fig. 6. Typical solid tungsten carbide piercing punches used in making armature laminations.

Fig. 7. (right) Sine bar magnetic chucks are used during finish grinding of carbide piercing punches.

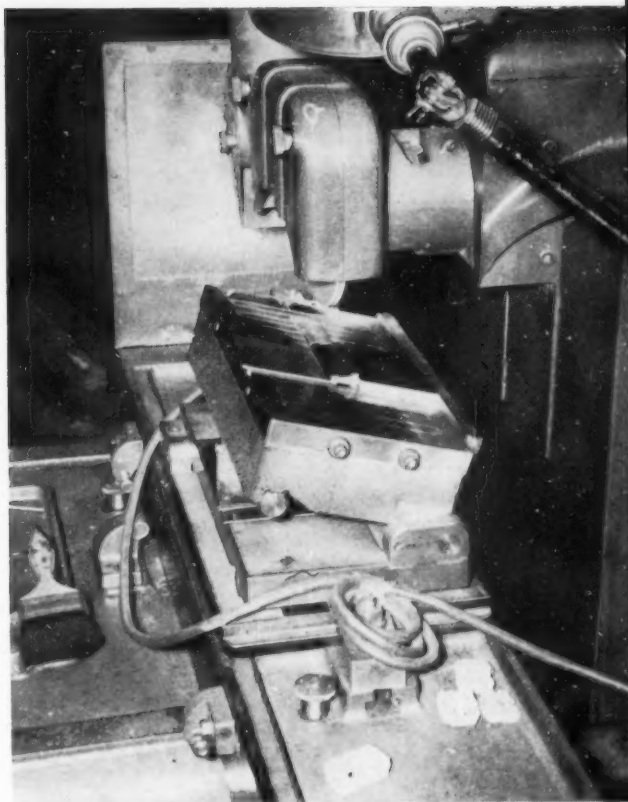
surface rather than in the hole. It is thought that a small particle of steel is pulled into the clearance between the punch and die. When the punch is withdrawn, edge pressure is probably exerted on the die, which results in chipping. However, runs of six million pieces have been recorded before chipping occurred.

Although a chipped surface can be resharpened with little material removal, bell-mouthing usually can be corrected only with removal of more material. If a bell-mouth condition is not corrected, excessive outward pressures within the hole will result. Normally, bell-mouthing is not too common over the life of a die.

Analyses of production of laminations for both carbide and steel tools are shown in the accompanying table. Although the original cost of carbide tools may appear prohibitive, the over-all cost for the life of the dies is actually 55 percent less than for steel. The table is based on production of 237,130,000 laminations. Experience has shown that carbide tooling should be used any time when production would be sufficient to wear out a steel die.

An advantage not revealed by this data is that carbide dies results in high-quality parts. It is almost impossible to throw a burr with a properly sharpened, unchipped carbide die. Explanation of this probably lies in the comparative coefficients of friction between steel and steel, and carbide and steel. The coefficient between carbide and steel is only about one-third as high as the coefficient for steel and steel.

After laminations were once produced by a carbide die, product engineers found that eddy current

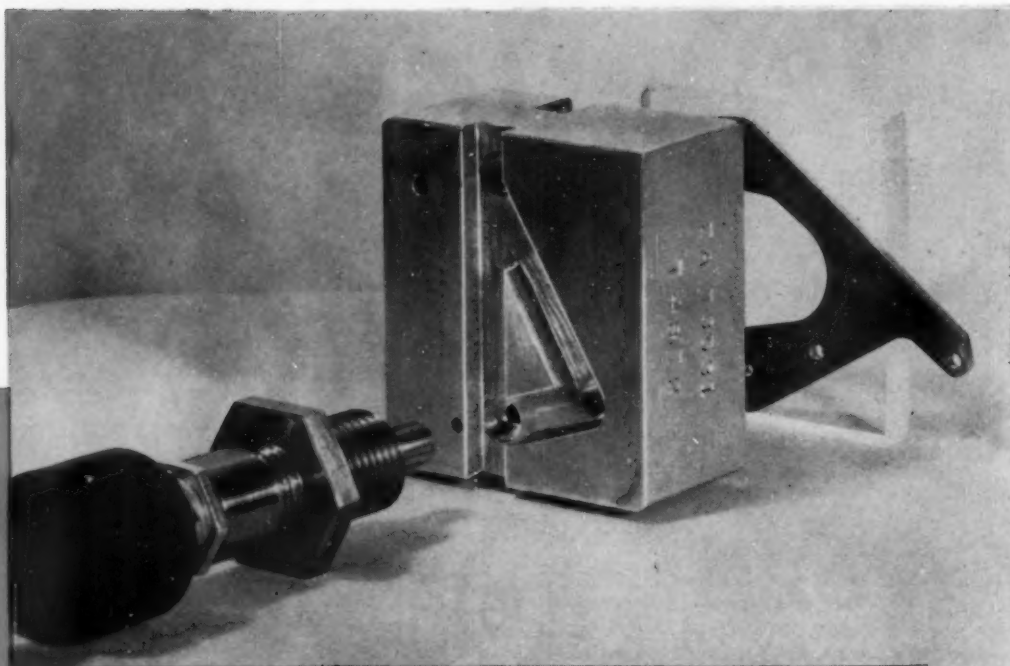


Lamination Production by Dies

Item	Steel Dies	Carbide Dies	Saving	(%)
Grinds and setups per year (No.)	1,614	115	1,499	93
Time to build, repair and grind dies (hours)	29,864	17,650	12,214	41
Toolroom men needed per year (No.)	15.9	9.4	6.5	41
Time for average run (hours)	5.33	75	69.67	...
Time for average run and setup (hours)	6.83	76	69.17	...
Press time lost in setup (hours)	2,421	115	2,306	95
Press time required per year (hours)	11,030	8,740	2,290	21
Presses needed per year (No.)	3	2.3	0.7	23

losses were reduced in the armatures and requested that all laminations be made with carbide dies. Because there are no burrs on laminations, and because the laminations are uniform in size and shape they can be stacked and pressed on a shaft easily. Insulators and conductors can be assembled in the slots with greater assurance that grounds will not develop during use.

Although carbide dies have been used successfully for several years and have produced uniform parts with cost savings, it is realized that much is still to be learned about construction and use of such tools. Continuous study is in progress.



how to reduce **medium-run tapping costs**

Fig. 1. (above) Layout of components used in fixture for tapping operation.

By John E. Verardo
Asst. to Gen. Supt.
The Liquidometer Corp.
Long Island City, N. Y.

TAPPING COSTS, or for that matter most machining costs, are a problem with the intermediate run. Short runs are not a problem because excessive costs will be accepted. Long runs are not a problem because tooling costs will not be excessive. Production men are constantly plagued, however, by the intermediate lot quantity. Not much tooling money can be spent; time is often a factor and the job may never run again in just the same form. What is an intermediate run? If it is necessary to stop and think whether a run is intermediate or not, then it is.

Basic fixtures provide one answer to reduction of costs for intermediate quantity runs. Applied to tapping operations, basic fixtures have yielded, *Fig. 1*, satisfactory results. Since alignment of the machine spindle and the unthreaded hole is a common and

time-consuming problem in any tapping operation, it is in this area that fixtures can reduce costs.

By inserting a pin *Fig. 2*, in the tapping machine table, directly under and aligned with the spindle, a locating center is obtained. If a holding fixture is then designed to use this locating pin for positioning parts under the tap *Fig. 3*, parts can be positioned quickly and without fumbling.

Such a fixture can be made from a block of soft material: aluminum, magnesium or plastic. The top surface is prepared to receive the workpiece—by use of locating pins or positive stops. Oversize holes are drilled in the top of the block to correspond with the workpiece holes. This allows for through penetration by the tap. Accurately located holes—large and deep enough to accept the entire locating pin—are drilled in the underside of the block directly under the workpiece holes. With such a locating block, all holes of the same size, with the same thread specifications and perpendicular to the same plane can be tapped in a single setup. It is only necessary to move the locating block so that each hole is moved under the tap in turn.

When all locating holes have been drilled in the bottom of the block, those for workpiece holes with the same specifications are connected by shallow, straight grooves. The grooves are deep enough to provide a bearing surface for the locating pin but not deep enough to permit the locating block to rest flat on the table when the pin and a groove are engaged.

In use, the locating block, with a workpiece in position, is placed over the locating pin, and pushed until the pin engages the groove and then slips into a locating hole. The first workpiece hole is then tapped. When the tap is withdrawn, the locating

block is lifted slightly from the locating pin, and with the groove as a positive guide, slid to position the next hole. Because the grooves joining locating holes are straight, locating movements are minimized. In addition, the grooved locating block tends to set up a pattern for operator movements, which further reduces nonmachining time. Also, there is little chance of the operator missing a hole.

This illustrates a basic technique that can be varied in many ways. For example, where machine spindle feed is powered, it is possible to have the locating pin automatically initiate the feed stroke. With such interlocked control there is no chance of prematurely feeding the tap. With a little imagination, this technique can be applied in other ways and with other secondary benefits.

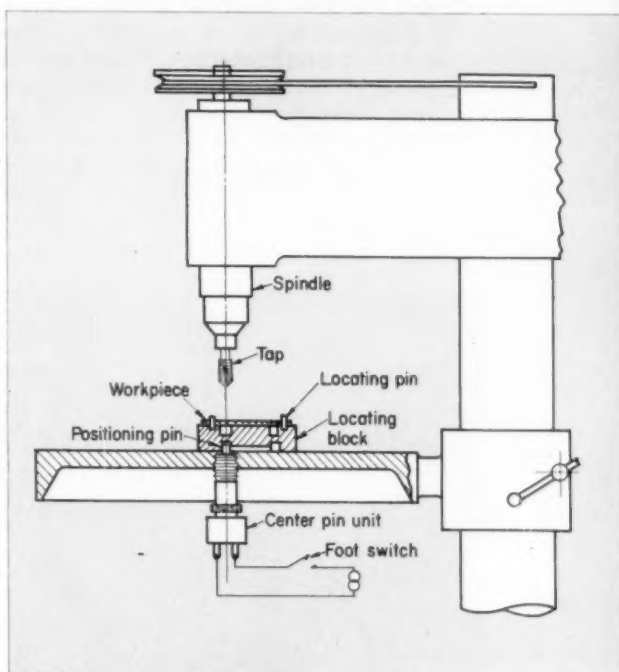
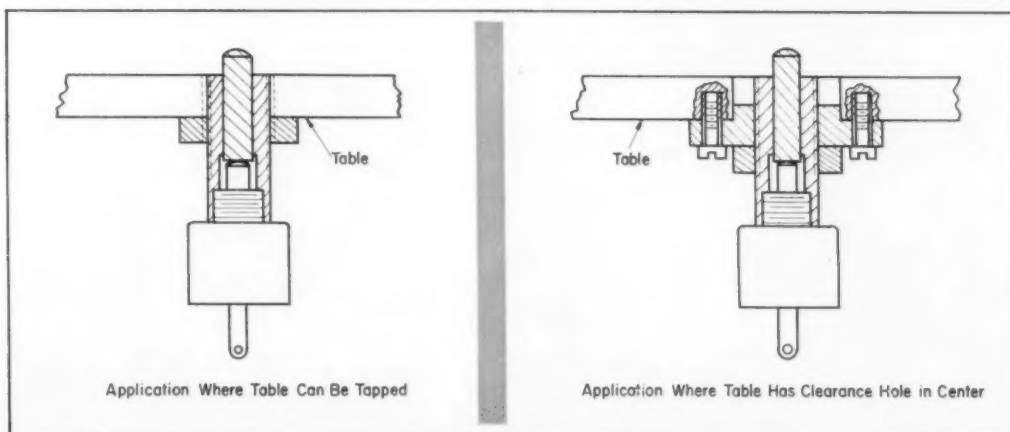


Fig. 2. (below) Locating pin mounting arrangements for two types of tapping machine tables.

Fig. 3. (right) Drawing of tapping unit using locating pin switch unit to initiate spindle feed stroke.



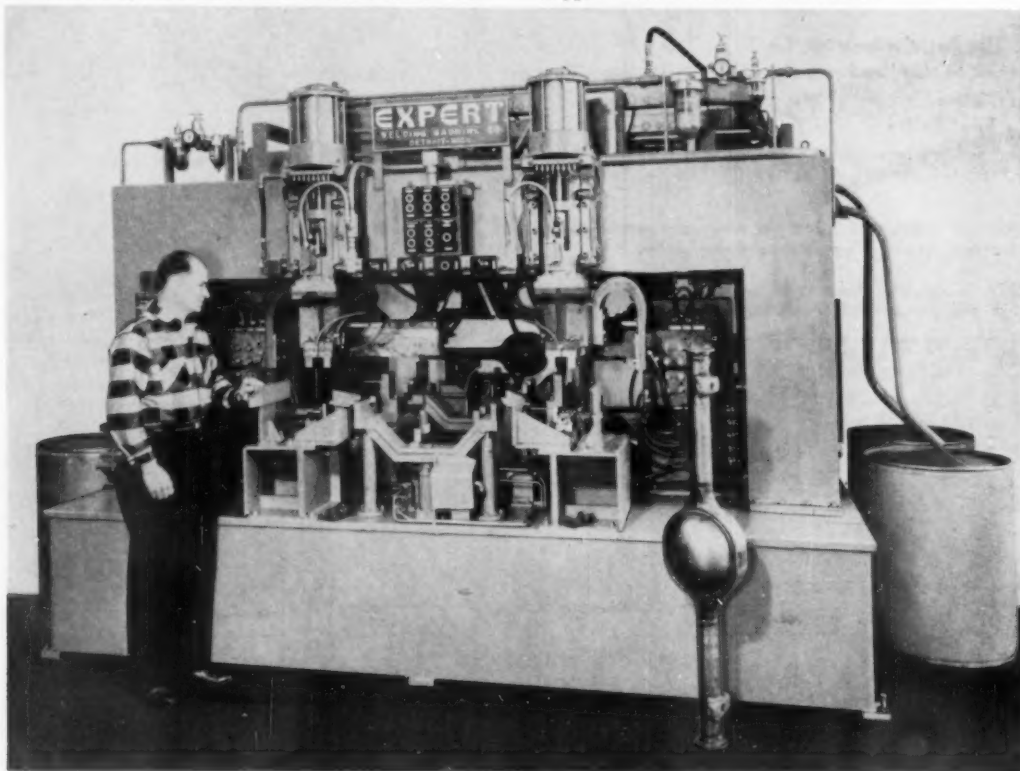
designed for **PRODUCTION**

WELDING MACHINE **combines** **two types** **of welding**

An automatic welding machine combines projection welding and carbon dioxide arc welding for the assembly of two stamped spring-support brackets to an automotive rear axle housing. An in-line transfer type machine, it projection welds the brackets for accurate location at one station and rotates the assembly under four gas shielded arcs to complete the weld at another station. This unit was developed by Expert Welding Machine Co., Detroit, Mich.

PARTS are automatically transferred with a mechanism powered by an air motor. After the projection welding step, the assembly is picked up on centers and rotated by an electric motor. After finish weld-

ing, the part is automatically deposited on slide rails at the rear of the machine. Wire for the inert-gas welding operation is fed to the heads from hoppers at the sides of the machine.



PRECISION HOLE BORER

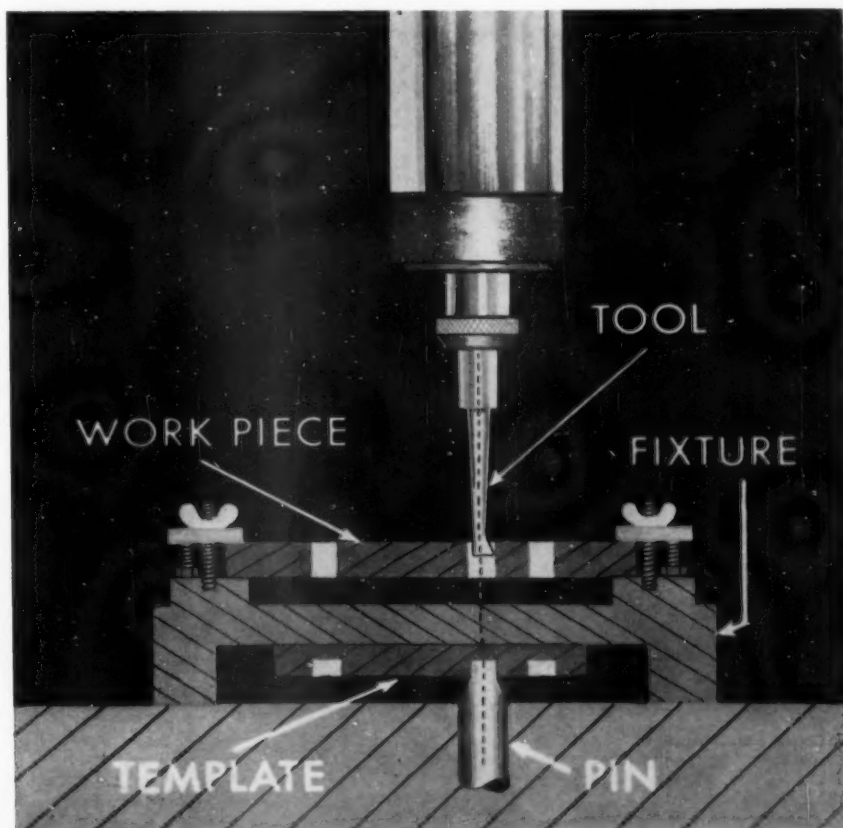
speeds repetitive workpieces

PRECISION HOLE BORING machine can operate up to eight times faster than conventional jig borers on production runs. It can be used for center-drilling, drilling and boring. Bore accuracy and hole spacing are accurate to within 0.0001 inch. The machine is made by The Canton Tool Mfg. Co., Canton, Ohio.

A template is first produced with standard, identical holes locating the centers of the various sized holes in the workpiece. This template is

mounted on the underside of the fixture that holds the workpiece.

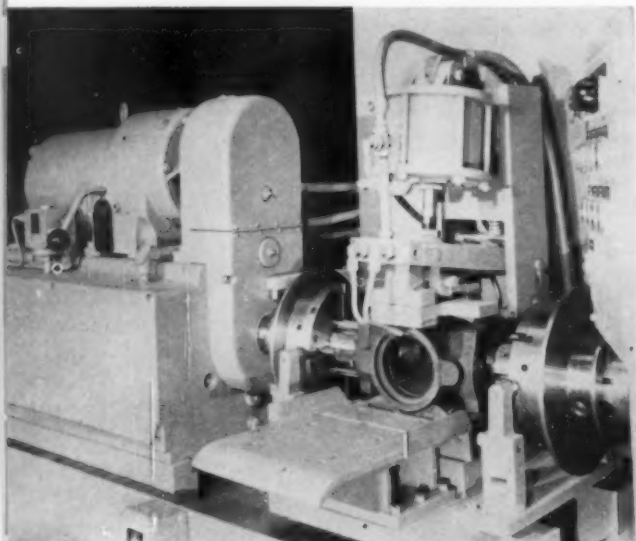
The fixture is positioned over a disappearing locating pin, which is in alignment with the spindle, so the pin engages one of the standard holes in the template. Successive holes are bored by simply moving the fixture until standard holes are engaged by the locating pin and selecting the proper tool for the bore size. Time-consuming setup and alignment are unnecessary for production parts.



DESIGNED FOR PRODUCTION

Double-End Machine Bores, Chamfers, Faces and Threads

By Ralph R. Holt
Engng. Group Leader
The Sheffield Corp.
Dayton, Ohio



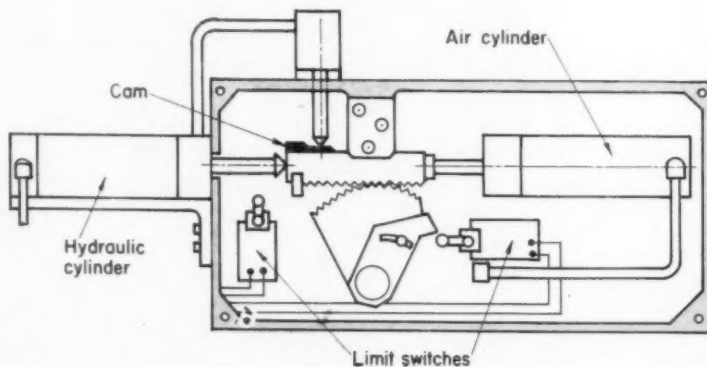
AIR CYLINDER holds valve bodies in nest type fixture. Nests are interchanged for two valve sizes. Allowance for the difference in casting lengths of two sizes is accommodated by tap lengths so spindle travel does not have to be changed between valve sizes.

Designed to finish both ends of three or four-inch gate valve bodies, this machine handles 45 parts per hour, including load and unload time. The machine comprises two Model 300 Precision-Pak® threading units and an air-clamped fixture. Power for each unit is available from three sources: 5-hp, 4-speed transmission type motor, 16-gal.-capacity hydraulic system and an air system.

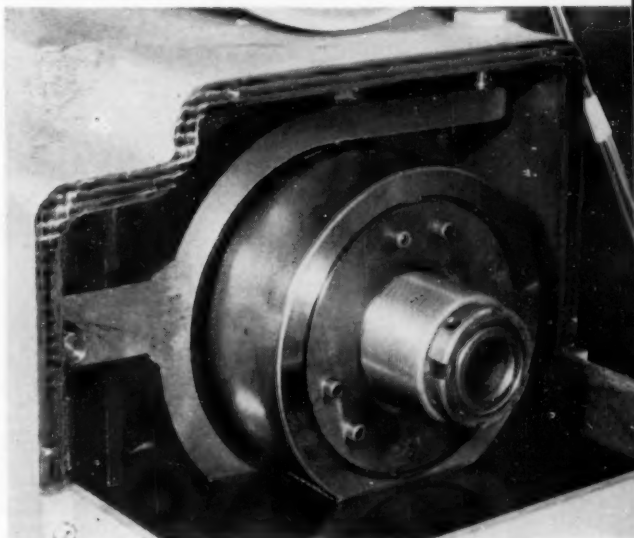
A part is placed in the loading chute, pushed into the nesting fixture and clamped. The spindles advance and bore the holes. When the facing tools are approximately $\frac{1}{8}$ inch from the part, spindle feed is reduced. A timed dwell at the end of the facing cycle allows the facing tools to square the faces of the valve body and cuts chamfer. The spindles return to their idle positions, lead nuts are closed and the taps are cocked. Spindles then feed forward on precision lead screws. When trip rings contact rollers, the taps begin to recede at the same rate as the angle of pipe taper. When full depth is reached, the taps collapse and can be withdrawn from the work.

The carbide boring tools are sharpened on the front only, so they need not be adjusted for diameter. They are adjustable for depth of bore in relation to the thread depth. The same forward limit switch that is contacted at the end of the boring stroke is contacted at the end of the threading stroke. Strokes are so determined that the chasers will not bottom in the hole and no facing will be done while operating with the lead screw.

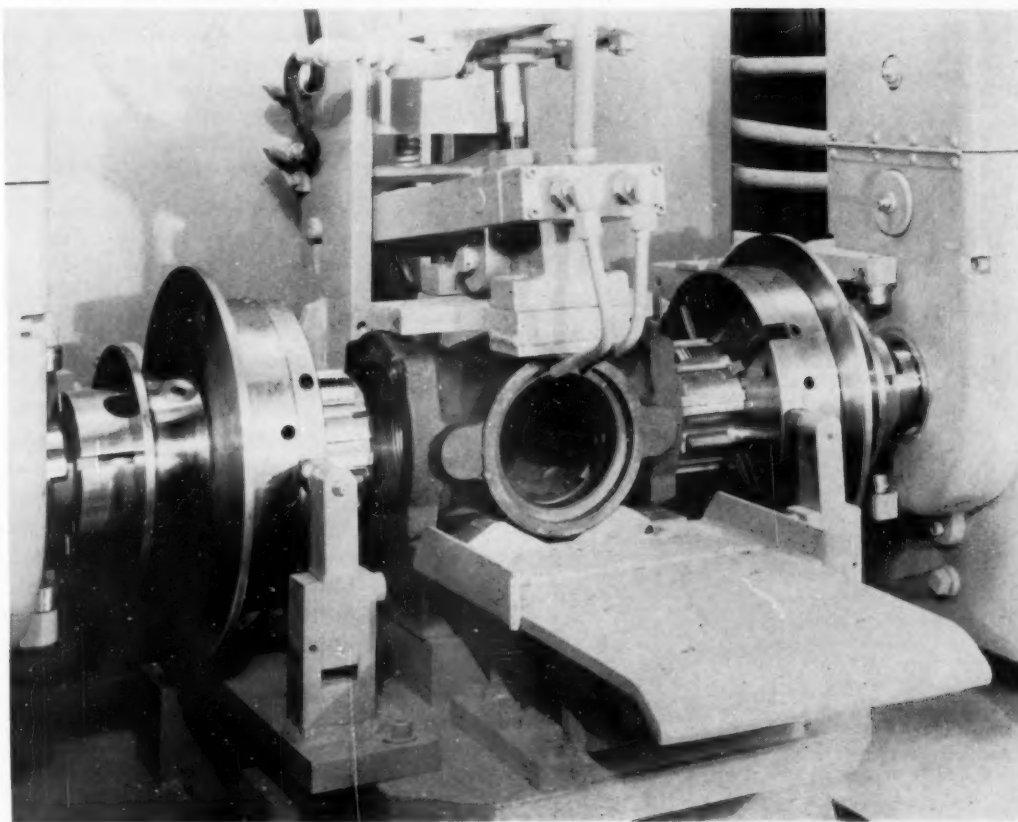
FIRST PASS of tools is actuated by hydraulic power through a rack and gear segment. A cam, connected to the rack, actuates a hydraulic valve and controls the feed rate for the different phases of the first operation. Rapid return of the spindle is accomplished by the air cylinder through the rack and segment. The segment is keyed to a shaft that actuates a yoke, causing the spindle to advance or retract. Both limit switch trips are adjustable.



SECOND PASS of the spindle is actuated by a precision lead screw and lead nut assembly mounted on the rear of the tool spindle. Pitch of the lead threads is the same as that required in the workpiece and lead accuracy is 0.0005 inch. Three hardened and ground lead nuts are closed around the lead screw by a collar. The collar is actuated by a yoke and an air cylinder. Changing from one pitch to another requires about five minutes.



TOOLS are collapsible pipe taps equipped with solid carbide reamer blades, high-speed steel chamfering cutters, carbide-tipped facing blades and high-speed steel chasers. During the first pass, the tap is collapsed.



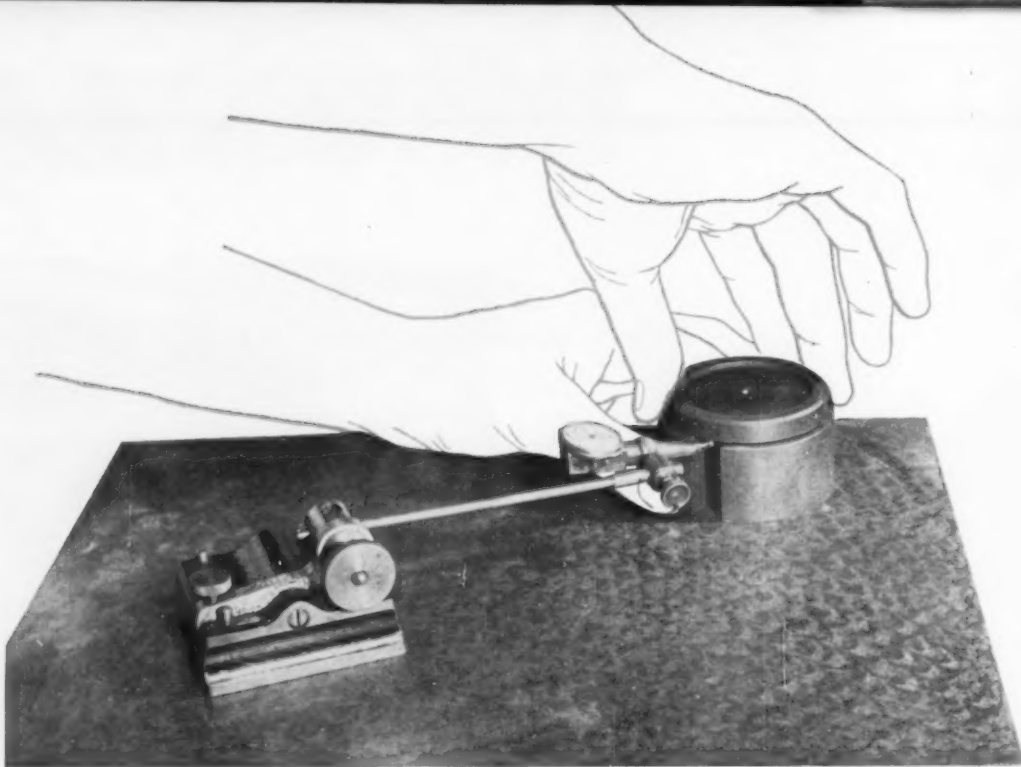


Fig. 1. Checking runout of a nut on a functional gage, designed to simulate mating parts.

FUNCTIONAL GAGING cuts production and inspection costs

By W. A. Brillhart*

Tool Engineer
Small Motor Div.
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Gaging represents a substantial segment of manufacturing costs. This being the case, it is essential to take a look at what is received for the gaging dollar to see if simpler gaging can be used without sacrificing part quality or performance. For many applications, functional gaging is the answer.

CONVENTIONAL GAGING practice is to measure dimensions, sizes and angles of a part without taking the mating part into consideration. The relationship or fit between mating parts is, however, all-important from the standpoint of performance and is, in fact, the basic reason for gaging.

Inspection is related to end use in functional gages, Fig. 1, which are designed to simulate the mating part. Often one functional gage can replace several conventional gages, with a corresponding reduction in costs. Of even more importance, how-

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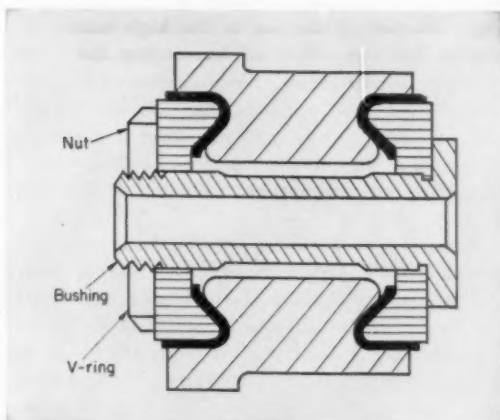
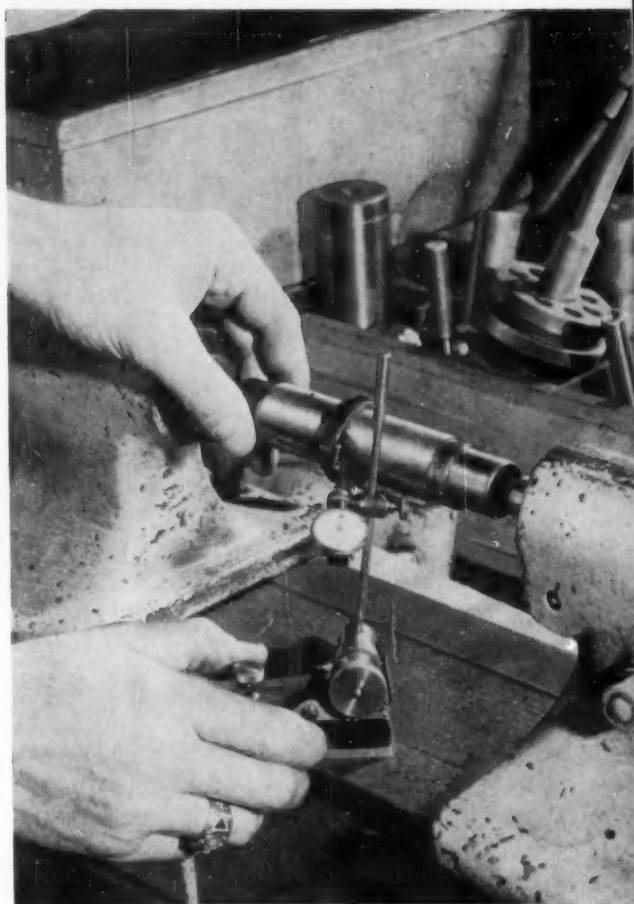


Fig. 2. (above) Nut and V-ring of commutator assembly are checked on functional gages.

Fig. 3. (right) Conventional method of checking face runout of nut with respect to thread.



ever, is the fact that through the means of functional gaging part tolerances can be used to advantage in machining operations without endangering final performance. The design engineer can thus specify factually tighter print tolerances with greater actual machining or fabricating tolerances.

These advantages are illustrated in gaging of a nut which is used to hold parts on a commutator assembly, Fig. 2. The inside face of the nut must be square with the pitch diameter of the thread and maximum runout is specified as 0.002 inch.

Thread machining limits for the nut are specified in the accompanying table. It will be noted that the minimum pitch diameter or "Go" for the nut is 1.23376 inches and the maximum pitch diameter or "Not Go" is 1.23826 inches, a 0.0045-inch tolerance. Maximum pitch diameter or external "Go" of the bushing, the mating part, is 1.23276 inches and minimum pitch diameter, "Not Go" is 1.22926 inches for a 0.0035-inch tolerance. There is 0.001-inch allowance on the external thread from the basic pitch diameter, which adds up to 0.001-inch minimum and 0.009-inch maximum spread or self-align-

ment available at assembly. The print specification of 0.002-inch face runout is based upon a positive condition and, unless the functional gaging method is used, part tolerances and allowances cannot be fully utilized in machining operations.

The most common method used to gage face runout is with a taper-threaded arbor, Fig. 3. After the part is screwed onto the arbor, the arbor is placed between centers and rotated. A dial indicator positioned against the face is used to determine the runout. With this method no consideration is given to allowances and tolerance, and it is difficult to get the same reading twice. This raises doubt as to the accuracy of the readings, and often good pieces are rejected and bad pieces accepted, causing trouble during assembly operations.

A functional gage, Fig. 4, eliminates these difficulties. The nut is screwed onto a stud which simulates the bushing to which the nut is ultimately assembled. A smooth shank on the stud is a slip fit into a ring which simulates the V-ring on the commutator. A slot in the gage ring allows the anvil on a dial indicator to be positioned under the

Thread Machining Limits
(inches)

Nut	Bushing
1.25000 Max Maj Diam	1.25000 Max Maj Diam
0.01624 Thr Depth 40 P	0.00100 Allowance
1.22376 Basic PD "Go"	1.24900 Maj Diam
0.00450 Tolerance	0.01624 Thr Depth 40 P
1.23826 Max PD "Not Go"	1.23276 Basic PD "Go"
	0.00350 Tolerance
	1.22926 Min PD "Not Go"

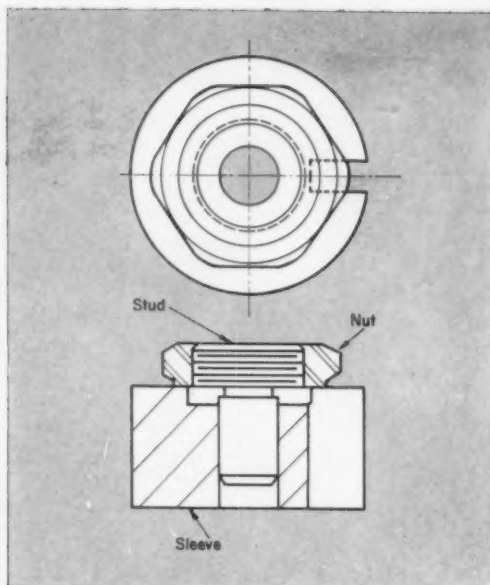


Fig. 4. Functional gage for checking face runout of nut. Threaded stud simulates bushing and sleeve simulates V-ring.

nut, and readings are taken as the nut and stud are rotated.

As the part is rotated against the base, it automatically adjusts itself to the limit allowed by the size variable, simulating assembly conditions. The pitch diameter of the stud corresponds to the "Go" pitch diameter of the nut, allowing the part to adjust itself to the stud and gage face by whatever amount the nut falls within its own tolerance. An alternative method would be to employ the "Go" pitch diameter of the bushing, taking advantage of whatever part tolerance is available on a given piece, plus the interference allowed between the two parts.

If the nut is machined to the low side of the tolerance, it will thread on the gage stud with little, if any, self adjustment. The actual face runout will be recorded and is therefore functionally required to be within the specified 0.002 total indi-

cator reading. Machining the nut to the high side of the tolerance has the effect of increasing the available spread factor. Since the gage stud pitch diameter is based upon the minimum size of the nut, an added spread factor is gained at assembly, unless all of the nuts are machined to the low limit and all of the bushings are machined to the high limit.

Inspection of the V-ring used on the commutator assembly is also accomplished on a functional gage, Fig. 5. A sleeve simulates the mating part on which the V-ring fits in assembly. The ID of the sleeve slip fits onto a base stud and the OD is taper ground to suit the size and tolerance of the V-ring ID. Since the V-ring is press fitted onto the bushing during assembly, no tolerance or allowance variable is available and the gaging is positive. The value of the functional gage for this particular operation is that the part is securely held for successive gaging operations, Fig. 6. The normal method, using a tapered arbor, allows the part to cock and shift, making the accuracy of the readings dubious.

The normally accepted practice of dimensioning is to specify each dimension with fixed tolerances. Gaging and fabrication problems can be simplified if the design engineer and tool engineer work together to predetermine the gaging and machining methods and use these as a guide to determine the dimensioning method. Reference dimensions, rather than concrete dimensions and tolerances, can be specified and the gages made to simulate the function of the part. The machine setup man and operator can use the reference dimensions as a starting point, then work within the limits of the functional gage. In most cases, one functional gage can take the place of two or three conventional gages. The most important benefit of functional gaging is not in reduced gage costs, however, but in increased production, reduced scrap and less down time.

Replacement of a fixed dimension by a reference dimension on a small casting, Fig. 7, made it possible to use a functional gage with a minimum of machining operations and less chance of rejects.

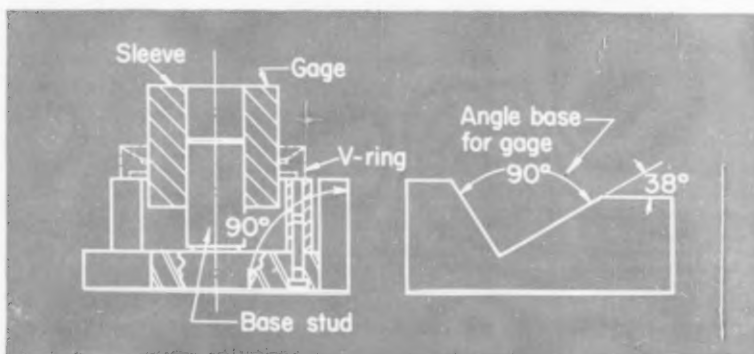


Fig. 5. Functional gage for checking V-ring.

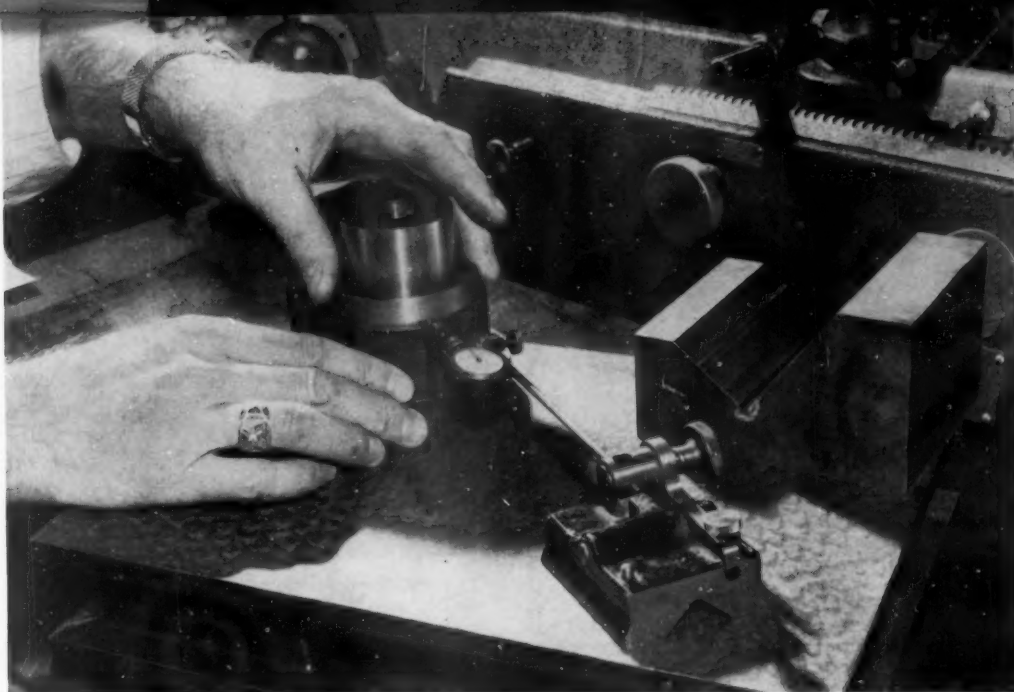


Fig. 6. Successive steps in checking V-ring on functional gage.

The shape of the part presented a problem, which was made more difficult by the original method of dimensioning.

As a result of consultation between design engineering and tool engineering activities, the 1.086-inch dimension was removed and replaced with a new dimension to an imaginary point, Fig. 8. Use of the functional gage eliminated a number of time-consuming operations which would have been necessary if conventional gaging techniques had been employed.

The hole at the right-hand side of the part as it appears on the drawing as originally dimensioned is the reference point for all machining operations. Steps in machining the part would be:

1. Broach the brush box
2. Drill the hole at the right-hand side of the part, nesting from the brush box and locating from the bottom
3. Mill mounting face, nesting from the brush box and locating from the hole drilled in the preceding operation
4. Drill and tap the balance of the holes, nesting from the brush box and locating from the mounting face.

Owing to tolerance build-up, no machining tolerance would be available for the drilling and tapping operation. Gages required are a hole location gage for the 1.086 dimension, another for the 0.933 dimension and a third for locating other holes.

Replacing the 1.086 dimension with the 1.690-1.710 dimension reduces the possibility of error in



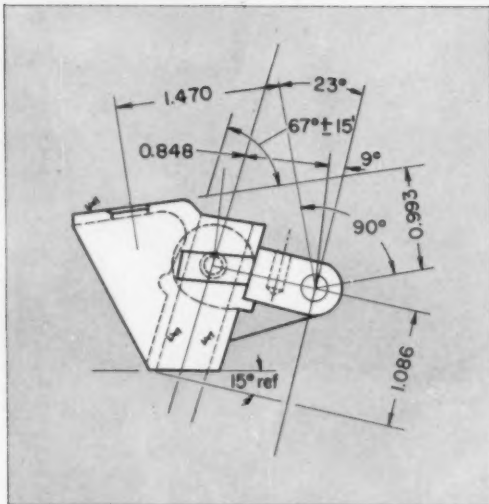


Fig. 7. Original dimensioning of small casting created a difficult gaging problem and complicated machining owing to tolerance build-up.

gaging and simplifies machining. Operations required are:

1. Broach the brush box
2. Mill mounting face, nesting from the brush box and locating from the bottom
3. Drill and tap all holes, nesting from the brush box and locating from the milled mounting face.

Only two gages are required: the functional gage

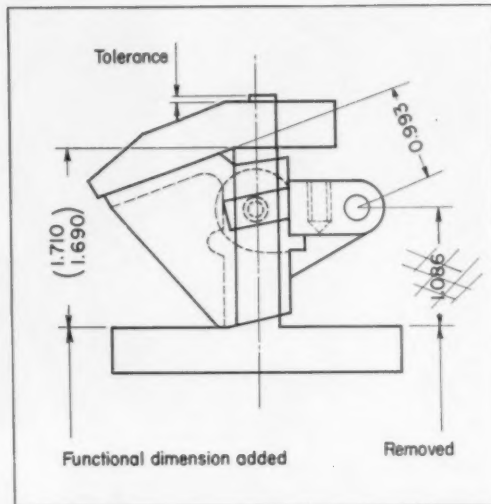


Fig. 8. Addition of a reference dimension to an imaginary point made it possible to use functional gage on small casting.

and a location gage for the holes. Tolerance build-up is eliminated and the simplified tooling and gaging, along with greater latitude in machining, helps to cut part costs.

This example is typical of the benefits obtained when the principles of functional gaging are applied. Study of the function of a part before gaging is designed can result in similar benefits in almost any production shop.

Stockpiling Production Capacity

Gearing the nation's defense production industries to meet emergency demands requires stockpiling now of "push-button" potential in the form of a standby reserve of readily expandable automated precision production capacity, according to W. Fay Aller, vice president and director of research of the Sheffield Corp. The big challenge—and responsibility—facing the machine tool industry is to keep ahead of the most rapid conceivable rate of obsolescence that can be foreseen in military weapons. To accomplish this task, it is necessary to plan the automated defense plant of the future now, in the fullest detail possible.

Acknowledging that there may be honest differences of opinion as to the imminence of a total push-button war, Aller points out that the volume demands of any military emergency require that we equip ourselves now with a push-button production potential in order to offset both time and manpower shortages.

Stockpiling is no solution because anything we stockpile today may be obsoleted tomorrow or a

year from tomorrow by developments in the fields of weapons, technology, research and design. This rapid rate of progress extends comparably to metallurgy, tools and methods, making it possible to stockpile only a few of the tools that may be required to step up to high volume production in the event of an emergency. Consumer industries, already taking their first steps toward automation as a matter of competitive survival, are setting the pace for defense industries to follow.

By applying the stockpiling principle in processing technology, as well as in materials, industry can help the nation's armed forces buy needed time insurance. Mr. Aller declares that equipping defense production plants with "push-button" potential can be done at comparatively nominal cost. It will involve only a small fractional portion of what we now pay for machine tools powering our defense and the cost would be relatively insignificant compared with the cost of the weapons and materiel annually delivered by those tools.

Surface Finish Inspection Methods

By C. H. Good
Production Engineer
Micrometrical Mfg. Co.

Available tools for the inspection of surface finish range from the fingernail to elaborate optical and stylus instruments. The author presents a survey of techniques for the evaluation and measurement of surface quality, and discusses the capabilities of each technique.

INCREASING EMPHASIS on the control of surface finish has made a knowledge of surface inspection techniques valuable to the tool engineer. Techniques used for measuring surface finish include scraping a fingernail along the surface of a part, comparing the "feel" of a part with a specimen of known roughness, visual inspection, reflectivity meters, inspection through a microscope. *Fig. 1*, and use of stylus instruments. Each of these methods has advantages and disadvantages for specific applications.

Probably the most common technique for inspecting surface finish is drawing a fingernail over the surface. This method has several limitations. Fingernails are blunt and cannot bottom the irregularities of a surface and interpretation is inaccurate, since it depends solely on human judgment.

Comparison specimens, which have surfaces with known roughness, make it possible to evaluate the

Abstracted from paper 24T32, "A Survey of Surface Finish Inspection Techniques," presented at the 24th ASTE Annual Meeting. Copies of the complete paper are available for purchase from Society headquarters.

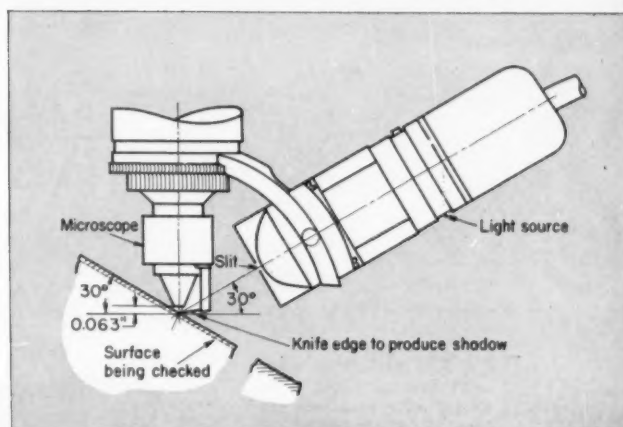


Fig. 1. Setup for making "shadow" photomicrographs of a specimen surface.

finish of a workpiece with somewhat greater accuracy. Surfaces of the comparison specimens are generally machined by the same method as the workpiece and provide a reference for tactual comparisons. Determining whether or not the "feel" of a given workpiece corresponds to that of a comparison specimen is still, as in the case of the fingernail test a matter of individual judgment, and the sense of touch is not sufficiently sensitive to make such comparisons accurate. The specimens are, however, valuable to the product designer since they enable him to see the appearance of various roughnesses.

Reflectivity Meter: Visual inspection is subject to similar limitations. The human eye, while unexcelled for locating surface flaws and scratches, is an inferior instrument for accurate evaluation of surface finish. The reflectivity meter, *Fig. 2*, is an improvement over visual methods since it eliminates the need for human interpretation of readings. The meter is used in a triangular system, with a light source in one corner, a light sensing element in the

second corner and the surface to be checked in the third corner. The light is first directed on the sensing element and the meter adjusted to full-scale deflection. The light is then reflected from the surface being checked to the sensing element. Meter readings show the percent of light reflected.

While this method is less subjective than direct visual inspection, there is not always a direct correlation between reflectivity and roughness height. Light rays tend to scatter unevenly when they strike the surface being checked, Fig. 3, making it difficult or impossible to obtain a true index of reflectivity. The most satisfactory application of the reflectivity meter is in repetitive inspection of surfaces that are

all processed in the same manner and whose function is to please the eye. This, in effect, is using the instrument to check the function rather than the finish.

Air Gaging: Another technique which is primarily used for functional checks is air gaging. Air gages are not recommended for the precise measurement of roughness because factors other than surface finish can affect the reading. A large bow in the surface of the part being checked, for instance, will leak air quickly, even though the roughness of the part may be very low.

The equipment is limited to inspection of flat surfaces or parts with large radii unless special heads are used. A projection on the surface will cause a much higher reading than a depression of the same dimension. This makes air gages poor as a means for obtaining average readings, but they are satisfactory for checking surfaces which function as seals.

Microscope: The techniques which have been described do not measure the surface finish. Rather, they provide a rough approximation of finish or comparison of one surface with another. Each technique is suitable for some applications, but all lack the accuracy required for precision measurement of surface roughness. This is also true of inspecting

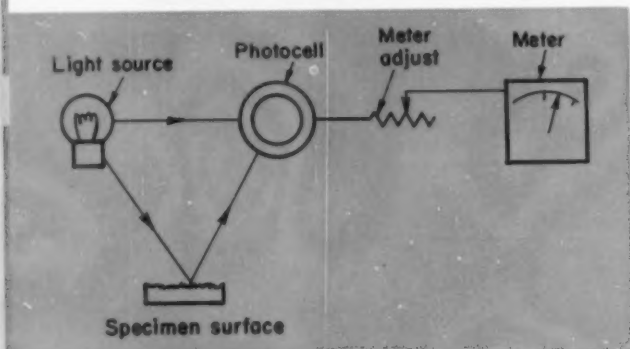


Fig. 2. Principle of reflectivity meter. Light is reflected off a specimen surface to a photocell and readings are in percent reflectivity.

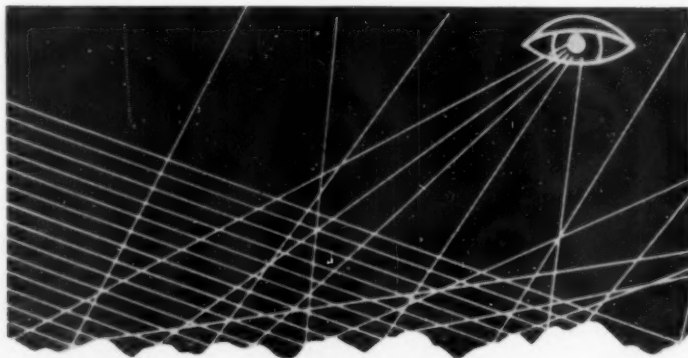
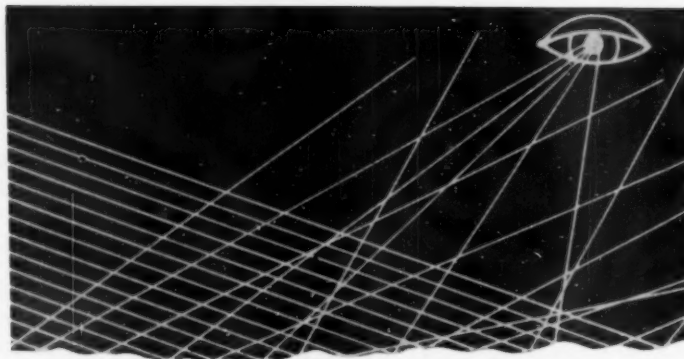


Fig. 3. Reflectivity does not always provide a true indication of height of irregularities. Relatively rough surface (upper right) reflects the same amount of light as smooth surface (lower right).



surface finish through a microscope unless special measuring techniques are used.

The first of these special techniques is sectioning. One method of sectioning is to cut a section normal to the surface and measure the heights of the irregularities. The height of the irregularities is much less than the spacing, *Fig. 4*, so the method is not satisfactory for evaluation of smooth surfaces. Taper sectioning, *Fig. 5*, exaggerates the height of irregularities without increasing the spacing and facilitates inspection.

The effect of normal sectioning, *Fig. 6*, can be obtained without destroying the part through the use of a microscope technique in which a shadow is cast on the surface. Deviation of the shadow from a straight line indicates the amount of roughness.

Surface profile height can be exaggerated by non-destructive means in an interference microscope, *Fig. 7*. In this technique a fringe pattern is cast on the surface of the part. If the surface is perfectly smooth, the fringes will be visible as evenly spaced lines. If the surface is rough, the fringes are not straight and the deviations can be measured. In either case, the surface must have high reflectivity or the fringes cannot be distinguished.

Accuracy of microscope checking techniques is good, using sectioning techniques on rough surfaces and interference techniques on smoother ones. Inspection is limited, however, to parts having flat surfaces or large radii and parts or surfaces must be small enough to fit under the microscope. It is possible to widen the range of usefulness of microscope techniques by using plastic replicas of the surface but microscope techniques are still limited. In any event, the field of view is small and microscopes are accordingly better suited to checking random irregularities than large surfaces. Microscopes are not adaptable to production checking because of the relatively long setup time required, and the possibility of damaging the fragile equipment.

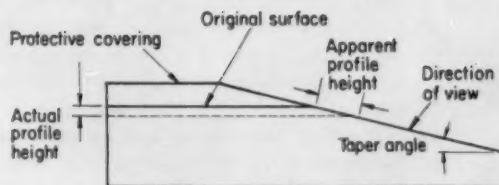
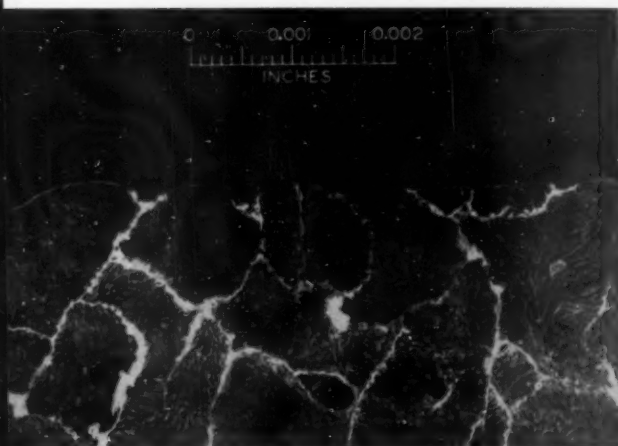
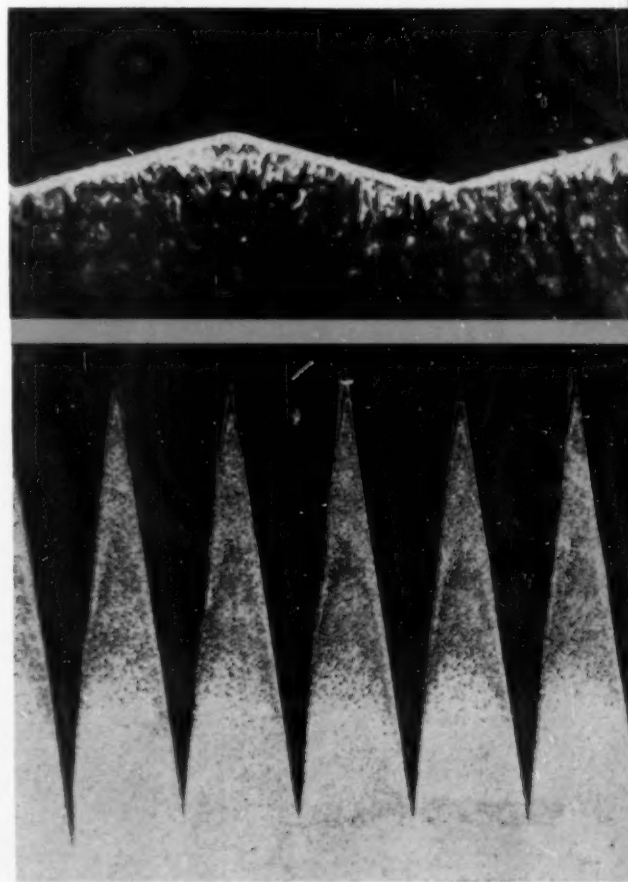


Fig. 4. (lower left) Photomicrograph of a normal section of a part. The small height of surface irregularities compared with their spacing makes it difficult to evaluate roughness, particularly when relatively smooth surfaces are being studied.

Fig. 5. (above) By cutting through a surface at an angle, actual profile height can be exaggerated.

Fig. 6. (below) Actual profile height of a precision reference specimen (top) compared with a taper section of a similar surface (bottom).



Stylus Techniques: In stylus instruments, the perpendicular motion of a stylus drawn along a surface is electrically amplified and recorded on a meter or chart. Two types of techniques are used: profiling, which provides a reading of total roughness height, usually in graph form; and averaging, which provides an average of the roughness over a length of trace, most often on a meter.

Profiling instruments are extremely versatile. Roughness height variations as small as two microinches can be measured and vertical to horizontal magnification ratios can be varied to allow the most suitable graphing of the data. With standard heads, profiles of any flat surface or outside diam-

eter can be obtained, and special tracer heads make it possible to obtain profiles in holes as small as one-eighth inch in diameter. The profiling technique has been used to make traces as long as nine inches and has recorded waves in surfaces of similar length. Average roughness can be readily calculated from the charts or read directly from the averaging meter provided on most profiling instruments.

The profiling instruments have two significant drawbacks: they are not suited to high production checking and they contact the surface being checked. They do, however, provide a permanent record of the surface profile as shown in Fig. 8.

Averaging equipment is accepted as the standard means of measuring surface roughness and is considered to be best suited to checking a wide variety of production finishes. The majority of surfaces can be checked with standard tracer heads. Special heads extend the range of applications so that almost any machined surface can be checked.

Experience with averaging equipment has pointed up four main sources of possible error. The first of these is the interpretation of meter reading. A graph of the meter reading of an averaging instrument is shown in Fig. 9. This reading was taken over a surface free from random flaws or scratches. The variation in average roughness is due to wear on the cutting tool or some other change in the cutting process. One possible interpretation would be to average the meter reading and decide on a reading of 10.5 microinches for the part. Another possible interpretation would be to use the maximum

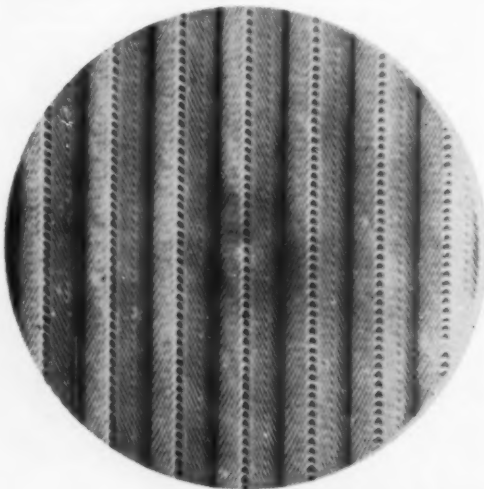


Fig. 7 (above) Micro-interferogram of standard surface roughness specimen. Twenty microinch average roughness; 83 microinches peak to valley.

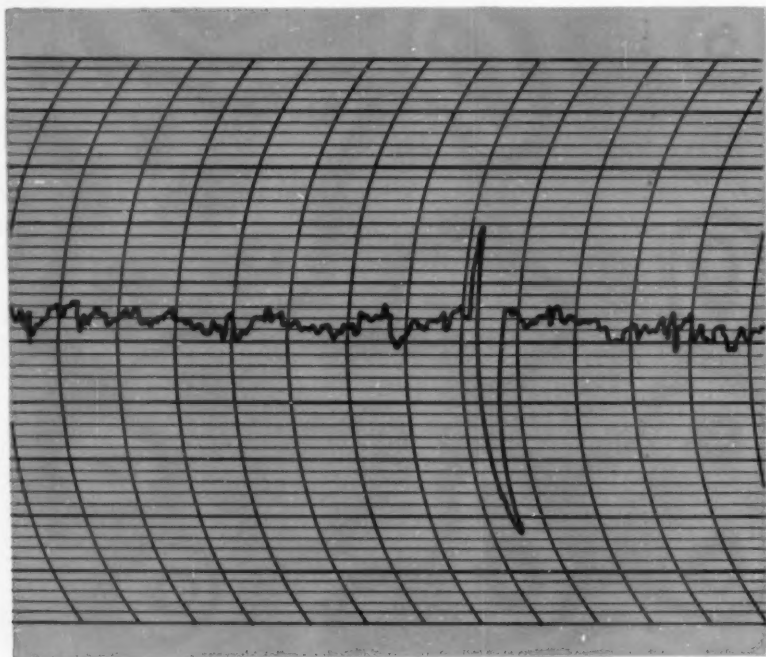
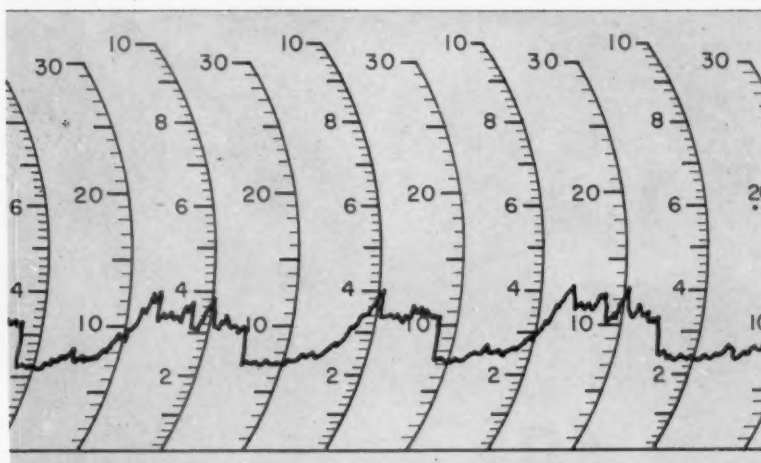


Fig. 8. (right) Profile record. Large irregularity is a scratch, with metal pushed up on one side.

Fig. 9. Typical meter reading of an averaging type instrument.



sustained reading of 12.5 microinches. The latter is the accepted interpretation.

The second possible error involves the roughness width cutoff of the equipment. Roughness width cut off is defined as the widest spacing to be included in the meter reading, and is equivalent to the tracing speed in inches per second divided by the low frequency cutoff of the amplifier. Roughness readings can change with changes in roughness width cutoff. To keep the roughness width cutoff constant, mechanical, rather than manual tracing should be employed, giving a constant tracing speed. For best accuracy, the highest possible cutoff should be used. When a definite cutoff is not specified it should be assumed that 0.030 inch is to be used. Narrow cutoffs are suitable only for short or special surfaces.

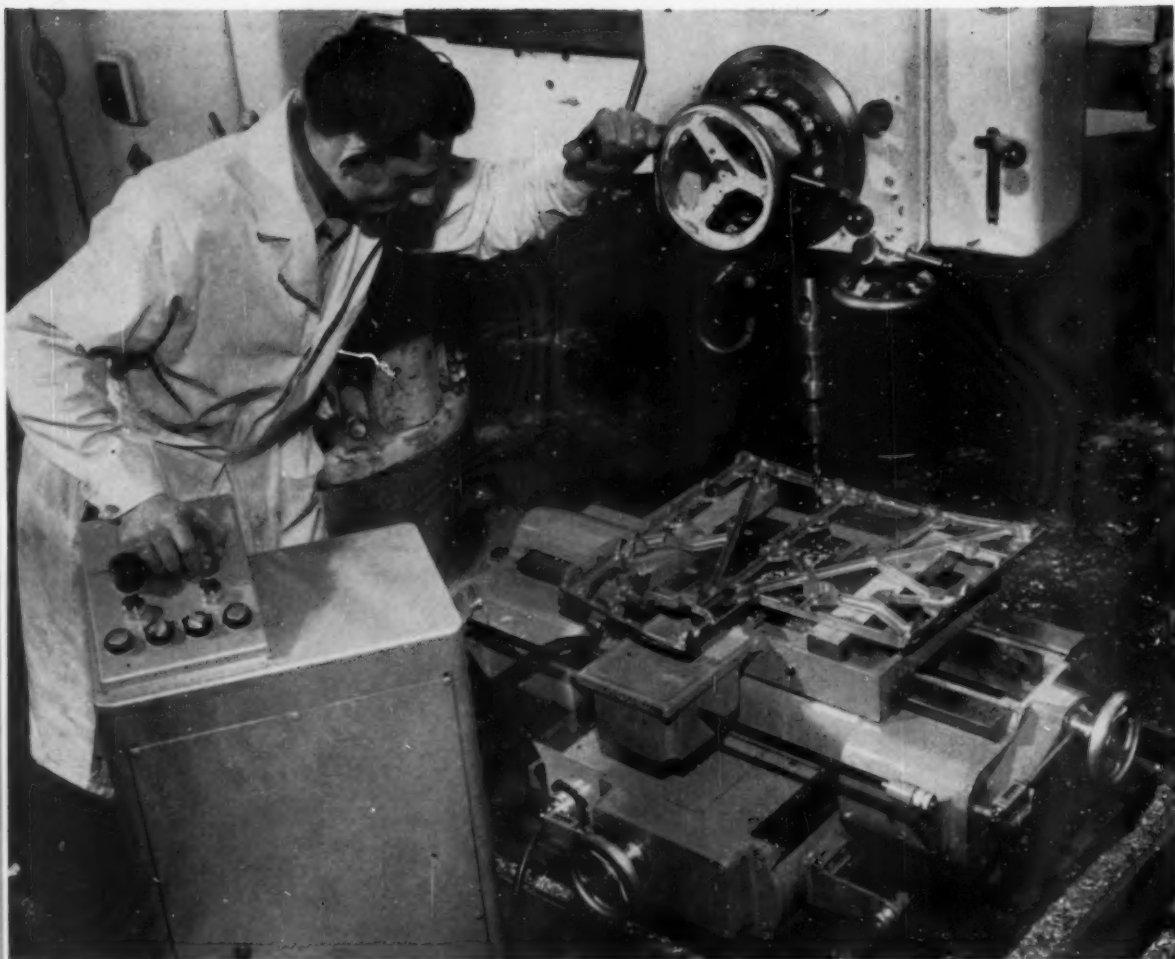
The effect of a third source of error, stylus radius, is insignificant in actual practice. The standard radius is 0.0005 inch, which represents a satisfactory compromise between diamond life and accurate readings.

A fourth possible source of error is the stylus scratching the surface being checked. If scratching is encountered, it is possible to reduce the force on the stylus, provided that the surface is smooth. On soft materials, such as Babbitt metal, scratching will occur. It is questionable whether surface finish control on such materials is required, since they would deform under functional loads as readily as they do under the stylus.

The accompanying table is designed to summarize the techniques discussed and show the best application of each.

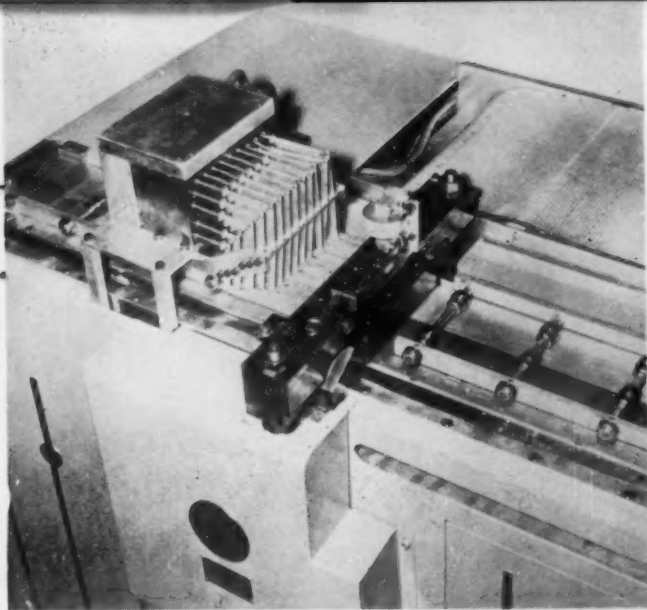
Surface Finish Inspection Techniques

	Tactual and Visual Checks			Functional Checks		Microscope			Stylus Instruments	
	Fingernail	Feel	Eye	Reflectivity Meter	Air Gage	Sectioning	Shadow	Interference	Profile	Averaging
Microinch Range	32 up	2 up	32 up	2 up	32-500	10 up	100 up	2-100	2-8000	1-1000
Shapes	flat & OD	flat	flat OD & ID	flat	flat & large diams	flat, OD & ID	flat	flat	any	any
Accuracy (percent deviation)	...	35	...	10	...	10	10	10	10	10
Effect on Surface	none	none	none	none	none	destroy	none	none	contacts	contacts
Dimension	none	height	none	percent reflected	air escape	total height	total height	total height	total height	average height
Ease of Reading	poor	fair	poor	good	good	fair	fair	fair	fair	good
Ruggedness	good	good	good	fair	good	poor	poor	poor	fair	good
Time for reading	short	short	short	short	short	very long	long	medium	medium	short
Surface Best Application	area rough estimate	area rough comparison	area flaw location	area check appearance	area check flatness	line research	line coarse soft surfaces	area fine soft surfaces	line research	line production checking



TAPE CONTROL of drilling operation is achieved through an index table which automatically positions part for production of 24 holes on radial drill. Setup is programmed from blueprint or master part. Indexing speed varies from 6 to 90 ipm, with slow speed used for final positioning to accuracy of 0.001 in. The Micro-Positioner is transferrable to operations on milling machines, turret drills and similar machines.

TOOLS at work



(Above) AUTOMATION of printed circuitry exemplifies trends in the fast-moving electronics industry. Automatic machine developed by RCA punches combination of holes needed for components to be inserted in printed circuit panels.

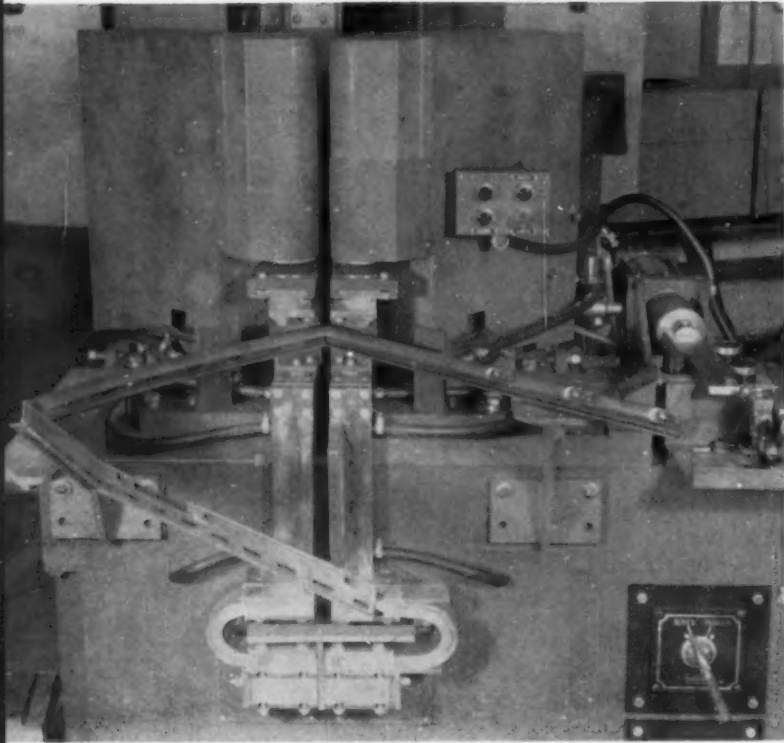


(Right) A SECOND machine, also developed and used by RCA, punches holes for components according to pattern programmed on tape. The blueprint type control tape, which is being inserted, is punched with holes in its circuit pattern corresponding to holes to be punched in the printed circuit boards. These two machines give incalculable savings in tooling, labor and lead time.



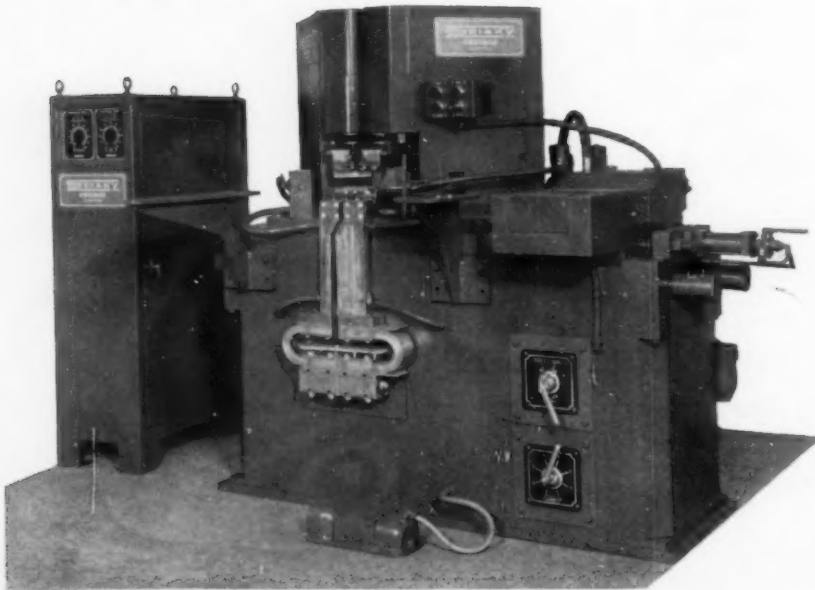
PRODUCTION of printed circuitry is further expedited with this automatic shear. Master boards containing multiple circuits are fed into the machine which automatically adjusts and positions the board for proper cutting of each strip. This is accomplished by sensing fingers which find marker symbols printed on the board.

TOOLS at work



FLASH-BUTT WELDING automobile door frames is accomplished in this high production machine at a rate of about 250 welds per hour. The piece-part is roll formed of low carbon steel. Two welds are required for the corner miter joints. Closeup at left shows part in position for such a weld. The exposed face of the door frame had to be porosity free because it is later chrome plated. A direct acting rocker-arm clamping system is used to hold the part during the weld time of $5\frac{1}{2}$ seconds.

—Photos courtesy Sciaky Bros., Inc.





Example of production operation using ceramic tool bits. A C-1045 forging, rough turned before delivery, is finished with ceramics. Although most applications have been in turning, ceramics are also used in facing.

ceramic tools

... in production and in the laboratory

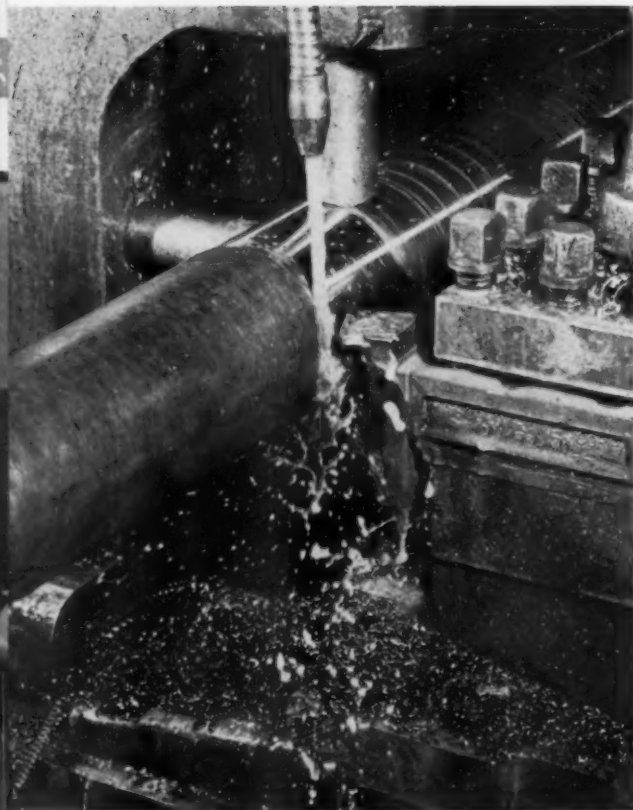
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Ceramic cutting tools are still used more in experimentation than they are in production but the fund of application information is growing. Author Hook here lists some of the characteristics of these sintered aluminum oxide tools and records rules developed from experimental and production experience. These ideas were first expressed at the 1956 Purdue Tool Engineers Conference.

CERAMICS SHOULD BE EXAMINED as a new family of cutting materials, not evaluated in terms of more familiar materials. They undoubtedly possess advantages for some machining operations but these operations should be determined without preconceptions. Different ceramics may be advantageous under varying conditions and will certainly supplement rather than supplant conventional tooling materials.

Tool engineers are now studying ceramics primarily because they anticipate being able to reduce production costs through faster removal of metal during cutting operations. Ceramics may also prove to be the only economic tool material for working new hard-to-machine metals. With light feeds and



Roughing cut on AISI C-1015 CF tubing. Cutting conditions: speed, 918 rpm or 751 sfpm; feed, 0.015 inch; and depth of cut, 0.040 inch.

high speeds, ceramics give high finishes. In fact, under equal conditions, ceramics generally produce better surfaces than carbides. Because aluminum oxide is plentiful, ceramic tool materials are non-strategic and should never be in short supply. All W & S turning operations with ceramics have been done with double-negative 5 deg.-5 deg. tools and holders. Rectangular tips with these rakes offer four cutting edges; square tips have eight. Lead and side cutting edge angles of 5 deg. or greater should be used to minimize shock upon entry into the work. As lead angles approach zero, the nose radius becomes more critical. At no time should this radius exceed $\frac{1}{32}$ inch. Data presented in this article are based on the use of $\frac{3}{8} \times \frac{3}{4} \times \frac{7}{8}$ -inch tips with nose radii of $\frac{1}{32}$ inch or less, negative toolholders, carbide shims, carbide backing and a carbide chip breaker.

Application of ceramics will be considerably eased if tip manufacturers will standardize sizes and shapes of tips, giving consideration to the toolholders now available. Each size of the so-called precision-ground throw-away tips requires a dif-

ferent type of toolholder which increases inventory.

Clamped-on tools appear to give the best results. If a ceramic cutting edge is going to break down, it usually does so soon after it is put in operation. For this reason, it is desirable to make tool changing simple. Some ceramic tips can be brazed but clamped bits should be used at least during initial applications. Rigid clamping of the tip in the holder is a must to prevent chipping of future cutting edges. Such chipping results from vibration under the clamp and thermal expansion of the holder.

With clamped-on tools, carbide shims are required for support. The shim serves to prevent possible anvil deflection from reaching the ceramic and acts as a heat conductor. In some experiments, the carbide shim has saved the toolholder. Upon failure of the tip, the shim cut for a few seconds allowing the operator time to stop the feed.

Carbide chip breakers, held both mechanically and by brazing, appear to be best. Brazing alone cannot be counted on because a faulty braze or heat from chip flow may weaken the joint and loosen the cutting tip. This is especially true when the chip breaker also acts as part of the clamp. The chip breaker should be set at an angle not quite as great as the side cutting edge angle or lead angle so the chip will be curled into the unused portion of the ceramic.

The minimum distance between the chip breaker and the cutting edge appears to be $\frac{1}{8}$ inch. Reduction of this distance leads to flaking of the tip and, in most cases, breaks the nose radius. By rule of thumb, the distance should be 10 to 20 times the feed rate when cutting at 1,000 sfpm or higher. It has become apparent that chip breaker setting is dependent on the cutting speed. At 1,500 sfpm, one setup will produce a short, brittle chip. With the same setup but cutting a 1,000 sfpm, chips will form a "bale of hay." More study is required on this relationship.

Ceramic cutting tips are used at speeds between 400 and 1,400 sfpm. On some materials, cutting speed goes as high as 3,000 sfpm. However, ceramic tool life is influenced by speed of cutting just as carbide life is. Depths of cut range from 0.010 to 0.300 inch. Feed rates vary from light finishing cuts to 0.027 ipr. Examples of some successful combinations of speed, feed and depth of cut for several materials are shown in the accompanying table.

During the earliest stages of cutting with ceramics, tool life was highly inconsistent. There has been gradual improvement in this characteristic. Early tests resulted in removal of 72 cu. inches of metal at 1,300 sfpm. Results are now more uniform and reach values as high as 1,080 cu. inches of metal removed under the same cutting conditions. Impact properties of ceramics are less consistent than tool life in straight turning, but indications, both here

and abroad, show that by accepting a slight reduction of hardness impact strength can be increased. This may lead to the use of ceramics in interrupted cutting operations.

Rigidity of the tooling is important when working with ceramics. To reduce vibration at high speeds, the driving dogs must be accurately made to balance and may have to be made of lightweight material. All possibilities for introduction of vibration should be eliminated. Continued vibration results in poor surface finish and can break the nose radius of the tip. Rigid positioning of the tailstock center seems to be one of the determining factors in reducing chatter. Unless this end of the workpiece is rigidly held, chatter will show up in surface finish, and is worse with ceramics than under the same conditions with carbides.

Several specific precautions have resulted from laboratory experiments. When turning, care should be taken so that there are no burrs left on the workpiece from previous operations or cuts. When encountering an edge with a burr, ceramic tools tend to flake. The tendency toward flaking may be lessened if a chamfer is ground on the side cutting edge where it is liable to contact a burr. Roughing cuts may be required on tube type parts where lack of roundness and straightness might cause high tool forces. It may also be necessary to alter the tooling to reduce whipping at high speeds. For the time being, the method of necking before turning is advisable. Since some ceramics can be abraded during dwell, necking will remove the possibility of a dwell.

It has been found, with some surprise, that coolants seem more suitable for use with ceramics than with carbides. Coolant helps to control the chip by weighting it down so it goes into the pan rather than flying around the room. In experimental production jobs, good results have been obtained with intermittent application of coolant. The ceramic tip was allowed to get hot and then coolant—water or mixtures of water, soda water and emulsified oil—was applied. There appears to be no tendency toward cracking.

Ceramic tools seem to last longer if they are used

continuously. With clamped-on toolholders, the tip is cool after a cut. If the tool is permitted to remain idle, however, the heat in the toolholder and tip support goes back into the tip. Hot tips have demonstrated a tendency to fail almost immediately upon entry into the work. Although still unexplained, it has been found that temperature of the workpiece differs after a rough cut or a finishing cut. With a $\frac{3}{16}$ -inch depth of cut, the workpiece is cold while after a 0.045-inch finishing cut, the workpiece is warm.

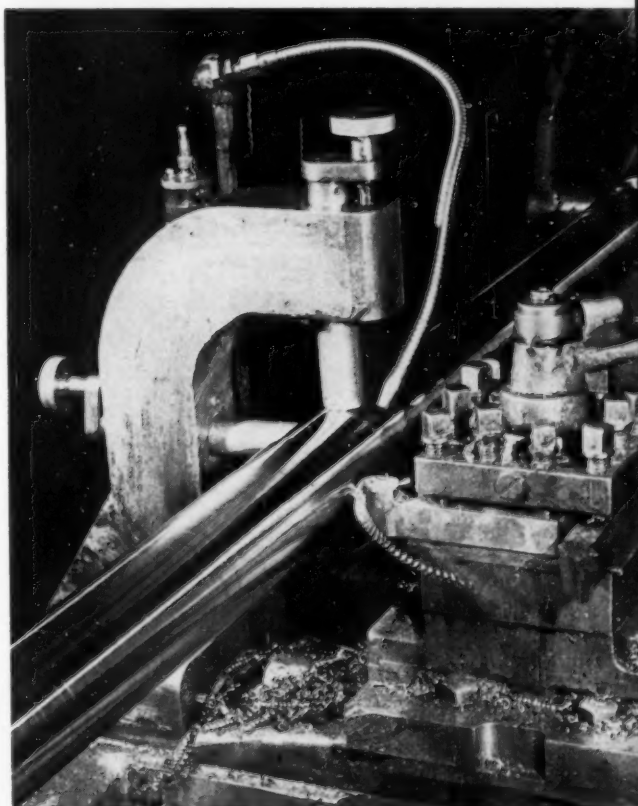
Ceramics may be prepared for metal-cutting with the same grinding techniques as used for carbides. A 220-grit diamond wheel is recommended to prevent cracking during the grinding operation. Care must be exercised when grinding small areas because the rate of material removal is relatively fast. As previously stated, ceramic tools should have nose radii of $\frac{1}{32}$ inch. Sharper radii will cut, but the finish is undesirable. With larger radii there seems to be a tendency toward chatter.

Power requirements when cutting with ceramics are approximately 80 per cent of the power needed by carbides under similar conditions. One theory

**Turning Speeds and Feeds
That Have Given Good Results**

Material	Condition	Hard- ness (Brinell)	Speed (sfpm)	Feed (ipr)	Depth (inch)
4150	Hot-rolled annealed	197	850	0.012	0.300
C-1045	Hot-rolled annealed	170	1600	0.012	0.100
C-1015	Cold-drawn seamless tube*	...	800	0.015	0.100
C-1015	Cold-drawn seamless tube†	...	975	0.022	0.025

Note: All cuts dry.
*Roughing cut.
†Finishing cut.



Finishing cut without coolant on AISI C-1015 CF tubing. Cutting conditions: speed, 918 rpm or 751 sfpm; feed, 0.022 inch; and depth of cut, 0.022 inch.

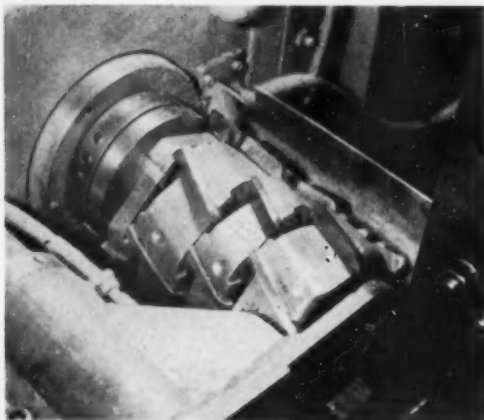
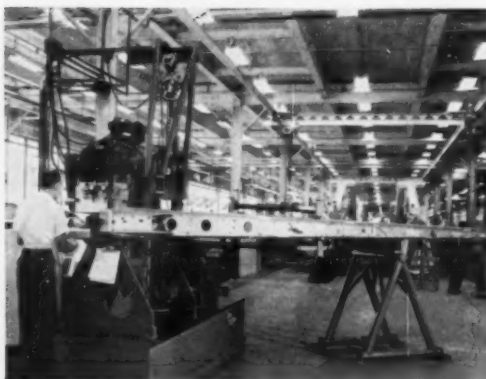
explains this fact by pointing out that the coefficient of friction is lower for the ceramics. This theory has not yet been completely checked.

Since foreign investigators are also testing ceramics for cutting tools, it is interesting to try to evaluate their work. Speeds up to 11,000 sfpm have been reported, but without giving an indication of the workpiece material, feed or depth of cut. Considerable work is being done with ceramics in interrupted cuts. Technical reports from Czechoslovakia indicate that lead angles as high as 60 deg, are being used to minimize shock upon entry into the workpiece. The literature indicates that Czechoslovakia and Russia are four to five years ahead of the United

States in research and at least two years ahead in production.

It has been estimated that it would take up to five years to achieve industry acceptance of ceramics in normal times. This period would probably be cut to one year in the event of an all-out emergency. By speeding research work on ceramic cutting tools this time lag would probably be reduced. Investigation into the uses of ceramics may promote the efficient use of the harder grades of carbide. This would certainly be a desirable offshoot from ceramic study. In addition, the aluminum oxide based ceramics may be just the forerunner of many new families of cutting tool materials.

Helical Carbide Inserts Solve Milling Job



Top. Overall view of special high-cycle milling unit. Wing here is in final stage of completion.

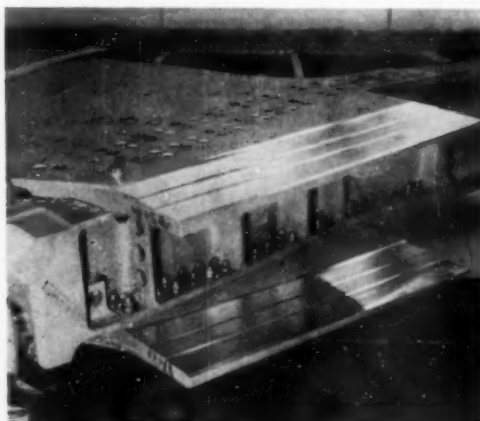
Above. Closeup photo shows the gang cutter ready for milling steps on the root shoulder section of the Super Sabre wing.

Right. Finished part requires four passes through the machine since both top and bottom of the two protrusions on the wing are stepped.

A tricky problem of milling the wing subassembly for F-100 Super Sabres at North American Aircraft has been solved by designing special cutters. The new cutters mill the critically located contour on wing spars at the point where they are attached to the fuselage. Helicarb inserts are ganged and stepped in sections to mirror the desired contour.

Using dampers on the part to minimize vibration, a cut 6 inches wide by $\frac{1}{8}$ inch deep is possible; feed rate of the machine at present is 48 ipm. In spite of fast table travel and lack of rigid hold-down fixturing on the outboard end of the wing, the shear-cutting action of the Helicarb design provides a finish of 20 microinches, rms, and better.

Construction is such that the four sectional cutter bodies are made separately with machined seats for the inserts. Inserts are then twisted to a 25-deg helix angle and brazed in place with a 10-deg positive rake angle. The four cutters are then assembled and ground to their specific diameters and dynamically balanced at 1800 rpm as an assembly.



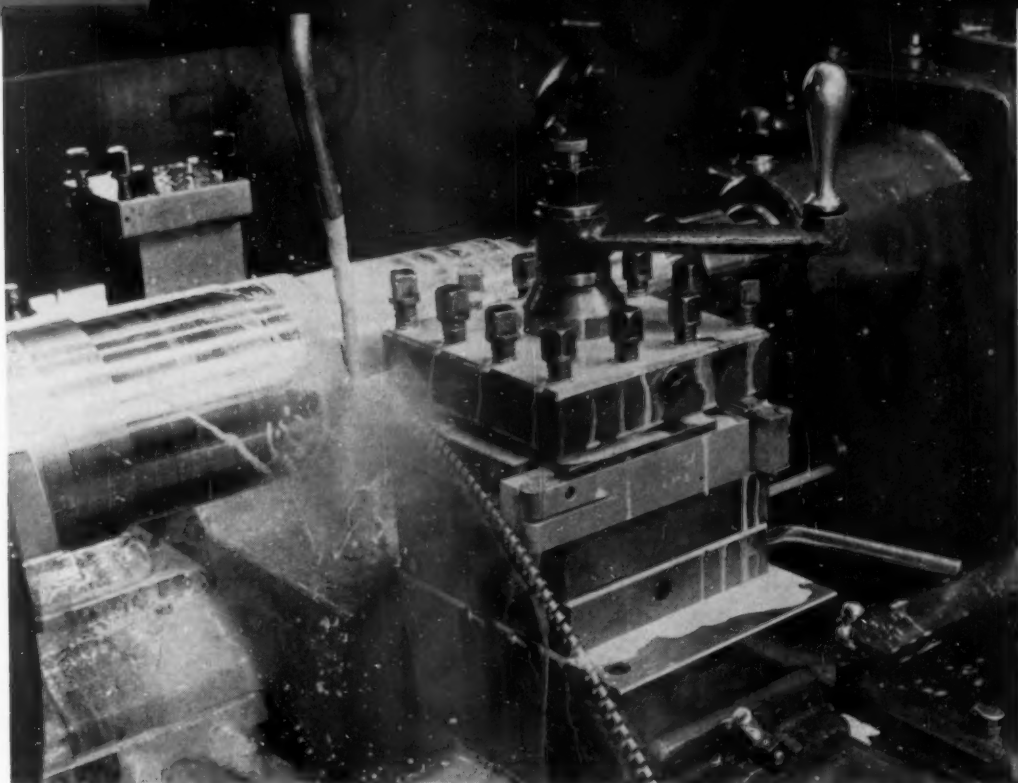


Fig. 1. Ceramic cutting tool machining AISI 1040 steel at 450 sfpm, feed of 0.014 ipr and depth of cut of 0.150 inch. Until recently ceramic tools were not thought suitable for use with cutting fluids. A duplicate tool is on the back of the toolholder.

machine tool requirements *of the Future*

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Everyone in metalworking is aware of the fast-moving developments in machine tool design. These presage even more exciting improvements ahead. In this article, an outstanding authority not only tells what to expect but why.

MAJOR REQUESTS made of tool machine builders the past 25 years have been associated with a reduction in machining cost, an increase in convenience of operation or an increase in workpiece precision. There is no reason to believe that requests in the future will be motivated by considerations other than these.

Predicting the future is a rather hazardous undertaking at best, and one who has observed the fate of other seers is inclined to be conservative. Therefore, no attempt will be made to be all-inclusive in this discussion. Only a few of the more significant

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Nomenclature

C = constant whose value is dependent on machine and materials variables
 M_c = machining cost per part (cents)
 n = exponent of the Taylor tool-life equation
 T = tool life (min)
 T' = tool life for minimum part cost (min)
 T_c = machining time per part (min)

T_s = down time to change tools (min)
 T_e = time to change workpieces (min)
 V = cutting speed (sfpm)
 V' = cutting speed for minimum part cost (min)
 x = machine, labor and overhead costs per minute (cents)
 Y = cost of the cutting edge (cents)

trends in machine tools and some of the developments that may come in metalworking will be considered.

Machining Cost

Total cost of machining operations on any part is made up of several component costs, and the mathematical summation of these individual costs, as defined in the accompanying nomenclature, is as follows:

$$M_c = xT_c + xT_s \frac{T_c}{T} + Y \frac{T_c}{T} + xT_s \dots (1)$$

The first term on the right side of this equation is the direct machining cost per part, including labor and overhead. The second and third terms represent the tool costs per part, including down time and the direct tool cost. The last term is the cost of transferring work to and from the machine, including

labor and overhead. The methods of determining machining costs have been previously published in greater detail (THE TOOL ENGINEER, Aug. 1955, p. 81).

Another important expression, the Taylor Equation, relating cutting speed and tool life, is:

$$VT^n = C \dots (2)$$

A straight line results when $\log T'$ is plotted against $\log V$. The slope of this line is n and the intercept corresponding to the value of V when $T = 1$ minute is C .

The cost per part will be a minimum when tool life is:

$$T' = \left(\frac{xT_s + Y}{x} \right) \left(\frac{1}{n} - 1 \right) \dots (3)$$

The speed corresponding to minimum cost per part is found by substituting T' for T in Equation 2:

$$V' = \frac{C}{T'^n} \dots (4)$$

Any development in tooling that increases the value of C or decreases T' will, of course, require the use of high machining speeds. The optimum cutting speed (V') is more or less independent, of n , although V' does decrease slightly with an increase in n .

When carbide cutting tools were introduced for turning and milling steel in the late thirties, the value of C was increased significantly and optimum speeds increased correspondingly. Soon after this development, machine tool builders were supplying machines capable of higher operating speeds and of increased power.

Recent Cutting Tool Developments

A number of cutting tool improvements have been introduced fairly recently that should lead to further increases in machine tool speed and power. These include:

1. Improvements of quality of steel-cutting grades of carbide by vacuum sintering and improved formulation. These new carbide grades, although hard, have

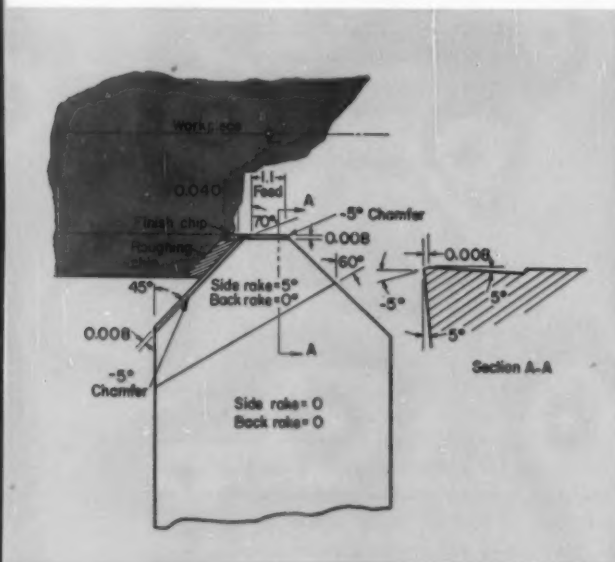


Fig. 2. Plan view of Kolesov turning tool in position against a workpiece.

less tendency to chip and, in addition, have greater crater resistance.

2. Adoption of clamped carbide tools to provide pieces of carbide of greater thickness free from brazing stresses.
3. Adoption of disposable carbide tools that have several cutting edges per piece and require no carbide grinding facilities in the user's plant.
4. Use of ceramic cutting tools.
5. Use of tools that are specially designed to have long life at high feed rates, such as that introduced by B. A. Kolesov in Russia.

The main influence of the first two items is to increase the quantity C in the Taylor equation and hence, to increase the optimum speed, as can be seen from Equation 4.

Disposable carbide cutting tools are an important development in decreasing tool cost and tool changing down time, both of which cause a decrease in optimum tool life and thus an increase in optimum speed. Moreover, use of disposable carbide tips shifts the tool life criterion from a given wear land value, such as the 0.030-inch value widely used in USA for brazed carbide tools that are reconditioned by grinding, to one of total destruction. This has the effect of increasing the constant C in Equation 4, which causes a further increase in optimum speed.

Ceramic tools may be briefly characterized as brittle and refractory. Like most materials, sintered aluminum oxide behaves in a less brittle fashion at higher temperatures and hence should be used at high cutting speeds. Furthermore, stresses on the cutting tool are less at high speeds, since the metal cut is then in the hot working region and so does not strain harden. The greater refractory character of ceramic tools makes it possible for high cutting speeds to be used, *Fig. 1*, without the cutting edge flowing plastically as the less refractory carbide tools are inclined to do at high speeds.

When ceramic tools are fully developed and in production, their cost should be significantly less than equivalent carbide tools, since the cost of raw materials and of manufacture should both be less. This in turn will lead to even greater speed by reducing cost of the cutting edge and, therefore, reducing the optimum tool life.

It is evident that there are many reasons for machine tool users to ask for increased cutting speeds in the near future. Since the cutting force is essentially independent of cutting speed, and the power consumed at a cutting tool is given by the product of cutting force and cutting speed, it is to be expected that the power required of machine tools will increase at least directly with the speed. In addition to this linear increase in power with speed, any trend in the direction of increased feed, such as exemplified in the cutting tool of B. A.

Kolesov referred to in Item 5, will lead to requirements for additional power.

The tool designed by B. A. Kolesov is meant to take roughing and finishing cuts simultaneously at unusually high rates of feed. This tool is apparently in wide use in Russia and many applications to turning, boring, milling, planning, drilling and other operations are reported in current Russian literature. Kolesov was awarded the Stalin Prize for this development and Russian engineers appear to be excited about it. If it proves in practice to be as useful as is claimed, it is a development that tool engineers in this country should know something about. A brief description of the principle applied to a turning tool is given below.

The Kolesov tool is designed to make two connected chips as shown in *Fig. 2*—a roughing chip and a finishing chip. Wherever possible the roughing cut is made with a large side-cutting-edge angle (SCEA = 45 deg.), while the finishing cut is made with a still larger SCEA of 70 deg.

When a tool with conventional end cutting edge angle (ECEA) is operated with high feed, a surface resembling a screw thread is produced. The Kolesov tool avoids this difficulty by having no ECEA on the clearance section of the tool. The flat section with no ECEA is made from 10 to 20 percent wider than the feed increment. Details of preferred tool angles for a carbide-turning tool used in cutting steel are given in the figure.

Table 1—Comparison of Conventional Carbide Tool and a New Precision Tool

Tool	Speed (sfpm)	Feed (ipr)	Depth of Cut, (in.)	Tool Life (min)	Cutting Time (relative)
Conventional	425	0.0056	0.100	60	11.3
Kolesov	425	0.0635	0.100	90	1

This development puts into practice something that has been known for a long time namely:

1. Tool life is decreased less by an increase in feed than by an increase in speed.
2. Tool wear is directly proportional to the number of feet of work material that crosses the cutting edge. This in turn means that, other things being equal, the tool life will vary inversely with the feed rate.

Some idea of how the Kolesov tool is meant to be used may be gained from TABLE 1, where representative conventional carbide-tool data are compared with data obtained with the new tool. It is to be noted that the Kolesov tool has a life that is 50 percent greater, while the machining time is reduced by a factor of 11 (by increasing feed, not speed).

The peculiar geometry of the Kolesov tool makes it possible to use high feed and still obtain a good finish on the workpiece.

Problems of Increased Speed and Power

About 1925, machine builders began replacing plain journal bearings by rolling contact bearings to support main spindles. This shift from hydrodynamic bearings to rolling contact bearings was completed in the 1930's. At present, many machine tool spindles are operating at the upper limit of speed for rolling contact bearings. Research machines, which have been built in recent years to operate at above average speed, have been equipped with special precision ball bearings lubricated by oil mist. It is not clear how the greater spindle speeds that will be needed in the future will be accomplished by rolling contact bearings.

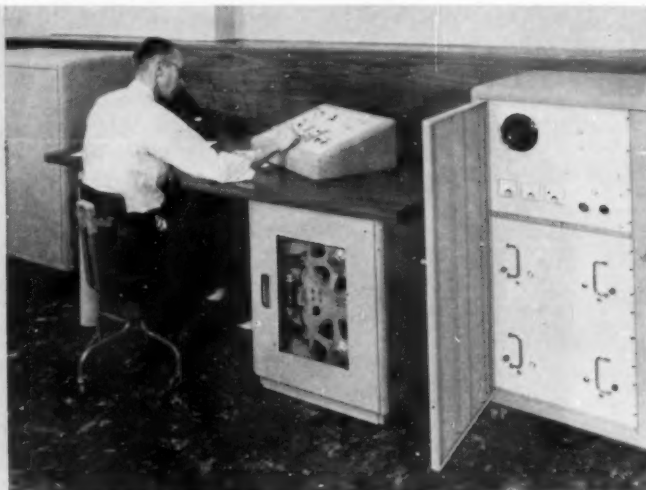
In 1925 the plain journal bearings used in machine tools were relatively crude affairs of low spring constant. Since this time there have been

are not to overheat or slip at high operating speeds. Further use of reinforced laminated plastic gears for the highest speeds, to provide quieter operation, may be precluded if the power to be transmitted must also increase.

Since both increased speed and increased power will probably be required simultaneously, high-frequency electric motors become attractive, since they are more compact in the larger sizes. Use of a hydraulic motor to drive a machine tool with feed-back control on the output speed becomes attractive for high-speed, high-power applications. Such a unit can provide infinitely adjustable speed control over a limited range, a feature that always is useful. A built-in tachometer would, of course, be an important feature of a machine having this sort of drive.

Extension of present geometric progressions of speed on machine tools leads to increments that are much too large at the high-speed end. The ideal solution to this problem is an infinitely adjustable system. If this would appear too costly, then a com-

Fig. 3. Programming a part for production on a magnetic tape controlled milling machine involves translation of dimensions into numerical coordinates. Unit is a West Coast development by Electronic Control Systems, Inc., Stromberg Carlson.



many improvements in hydrodynamic bearing design that have not been tried in machine tools. Today it is possible to provide bearings of greatly improved stiffness that do not depend upon metal-to-metal contact for their guiding action. It would thus appear that hydrodynamic bearings should be re-examined by the machine tool designer engaged in providing machines of increased speed capacity and rigidity.

Other problems associated with increased speed involve gears and clutches. It is likely that machines of conventional design will shift to helical gears when speeds are increased. Clutches then become a necessity to obtain changes in speed. Attention to the design of such clutches will be necessary if they

promise solution might be obtained by designing machines that are used for either high or low speed ranges rather than attempting to cover the entire range with a single machine. The machine tool industry might well see this type of specialization in the near future as one solution to the high-speed machining problem.

Machine Tool Accuracy

Users of machine tools will continue to be interested in machines of greater accuracy and convenience. With increased speeds and increased power, need also frequently exists for greater rigidity. For example, use of harder carbides and ceramic tools are trends that require not only higher speeds

but increased rigidity of the entire system. Greater use will have to be made of aircraft type design techniques that provide greater rigidity without greater weight. Welded machine frames may be more widely used in the future in order to take advantage of the threefold increase in the modulus of elasticity that is obtained in going from cast iron to steel.

The precision of most large machines is limited by the rigidity of the concrete foundation on which they are placed. Both the user and the builder find that there is far more harmony if the rigidity of the machine is self-contained and not dependant on a subbase supplied by the user. Also, incorporation of isolation mounts on machines enables them to be more independent of floor-borne vibrations produced by neighboring machines. The builder of machine tools should find the inclusion of vibration isolation mounts for his machines a good investment in public relations. It should be assumed that the average user will want to put a grinder next to a shaper, regardless of the vibration problem, if this helps reduce costly materials handling in his shop.

Combined Operations

The combination of operations that has been practiced on automatic screw machines for many years is an important way of saving time. This idea is being more widely used and one sees combinations of sawing and turning, and other relatively strange but effective combinations.

The more recent combination of gaging and machining is one that will undoubtedly be used more widely in the future. Use of air gaging equipment that checks the product as it is made is an effective way of not only saving time and labor, but also in reducing scrap losses. The user of machine tools will undoubtedly demand wider application of the principle of simultaneous machining and measuring in the future.

The inclusion of a primary measuring system built into such machines as lathes and milling machines would be convenient for small-scale production. Modern developments in measuring techniques now make it possible for the lower cost machines to be supplied with a built-in measuring system, such as that which has been only feasible in the past in such expensive machines as the jig borer.

Automatic Control

More automatic control of machine tools is inevitable as a consequence of the ever rising cost of labor and the upgrading of personnel. A number of machine tool builders have already developed preselection devices for their machines by means of which machine time may be saved by having the operator feed information into the machine for the next operation while the present cut is being taken.

Several punch card and tape systems of accomplishing this presetting of operating conditions automatically were exhibited at the Machine Tool Show in Chicago, Sept. 1955. This is but a first step in the automatic control of machine tools.

A number of machine tools have been built which are programmed through an intricate sequence of motions automatically, the information being coded in digital form on a punched tape. The first unit of this type was constructed at MIT several years ago. This was a milling machine with three degrees of controlled motion. The controlling unit moved the tool in three mutually orthogonal directions, the minimum motion in any direction being about 0.001 inch. This machine, like all other similar ones, is provided with feed-back control such that the amount the tool is scheduled to move is compared with the actual motion, any difference detected being immediately applied as a correction. Since the appearance of this machine, others have been built for special jobs such as the machining of cams or of special aircraft components.

This early machine was criticized by machine tool builders as being too complex, particularly with regard to the electronics employed, too difficult to code from a drawing and too costly. Many builders were convinced that this idea was impractical and a dream of the distant future. These estimates have, however, proved to be the usual reaction to a new concept. Today, these same builders are busily engaged in producing automatically controlled machine tools of their own. These units are for the most part simpler, although more specialized. However, all contain a large number of electronic components.

Automatic machine control has attractive possibilities at both high and low levels of production. In mass production it is possible for one controlling unit to operate a whole bank of machines, thus offsetting the high cost of control equipment. On the other hand, special-purpose machine tools can also profit from automatic control, particularly in the production of intricate parts. For example, one manufacturer of jig boring machines is designing a digital unit for his machine that enables a complete part to be made by use of a punched tape. Jig boring jobs are easily programmed, since drawings of parts produced on such machines are dimensioned from two reference lines, a practice that greatly simplifies programming the automatically controlled machine. It is reasonable to expect that when automatic control of machine tools comes into wide use, a major change will occur in drafting practice, drawings then being dimensioned according to techniques that are more favorable to programming, Fig. 3.

The previous mentioned jig boring application of automatic control also provides an automatic



Fig. 4. Flow turning a typical workpiece on the special lathe developed by Lodge & Shipley.

correction for temperature changes of the work when nonferrous alloys are machined. A thermocouple provides a thermoelectric electromotive force proportional to the difference between the standard 20 C reference temperature and that of the machine and an automatic correction corresponding to the difference in linear coefficients of expansion of the tool and work is made on the standard instructions fed to the machine by the controller.

This is a feature that is easily incorporated into an automatically controlled machine but not available under conventional conditions. It also represents a different approach to precision than that which is normally taken. The usual method of making something with precision is by complete control of all variables. While this is a straightforward approach, it is sometimes costly and difficult. An alternative procedure involves allowing something to vary and then continuously correcting for the variation.

Another interesting example of the latter procedure is to be found in the spectrographic ruling engine of Dr. George R. Harrison of MIT. This machine must scribe 30,000 lines per inch on a metal coated glass plate using a special diamond tool. The spacing of the lines must remain constant to a few microinches over a distance of several

inches to insure proper diffraction.

The conventional approach to this problem has been to attempt to hold all variables rigidly fixed. In the new approach adopted by Dr. Harrison, the spacing of the last two lines produced is compared with a standard spacing and an appropriate correction made to the next line ruled. In this way the absolute spacing of two lines can be held to a closer tolerance than would be possible by the conventional direct approach.

One interesting possibility that is attractive for small-lot production is the playback system of automatic control. By this method a skilled machinist makes one part by hand and a magnetic tape or similar record of all operations is recorded. When this record is played back all of the motions are reproduced and a number of parts identical with the first may be made. The metalworking industry will undoubtedly see several devices of this sort placed on the market in the future.

One element that is missing in all present automatic-control devices is a system of feedback from the workpiece. Present feed-back control systems merely compare the command and the tool or table motion. Need exists for a simple system that goes to the finished part and feeds back information as to what has been produced, so that a suitable cor-

rection may be made. Such a device would include tool and work deflections, and tool wear in the feed-back loop. When such a system is developed, it will be possible to continuously correct the tool and thus make possible a reduction in the part-to-part variation.

In the high-production industries, such as the automotive, there will be an increasing trend toward complete automation where automatic machines are connected together by automatic conveying equipment. In the past the automotive industry has scrapped large numbers of special machines with each model change. This practice will have to be altered since automatically controlled equipment is too costly for this sort of operation. Probably the answer to this problem will lie in requiring the standardization of control equipment, so that it may be readily shifted from one machine to another when a new setup is made. Thus, machine tool builders engaged in the design of automatic control equipment should give attention to standardization of equipment and the possibility of building multi-purpose control devices.

For ease of servicing, it is important that an entire unit be broken down into many subunits, so that a faulty element may be quickly located and the entire subassembly replaced. The high cost of an automatically controlled machine makes it imperative that the down time for repairs be kept to an absolute minimum.

Nonchip Forming Processes

Whenever it is economically advantageous, parts that were previously machined should be produced by nonchip forming processes. Several examples of such processes have appeared in the past few

years and these either affect machine tool sales or offer the machine tool builder an opportunity to diversify.

Two American machine tool builders are now producing flow turning lathes. These machines produce parts by causing a hardened tool steel roller to press an initially cylindrical workpiece against a shaped mandrel, *Fig. 4*. The desired shape is imparted to the work quickly by plastic deformation. Current machines are capable of reducing the workpiece section by as much as 75 percent. This is an example where parts that were previously turned are now flow turned and the machine tool builder has diversified by producing the equipment.

Another similar development is the high-speed rolling of splines and gears. Parts of surprising precision can be produced by cold forming in specially designed machines.

An example of a nonchip forming process that is in direct competition with metal cutting is the process called chemical milling. This is really a controlled etching technique developed by the aircraft builders for removing unwanted sections of aluminum from panels by masking them and placing in a hot alkaline bath. This process is said to compete favorably on a cost basis and eliminates the need for high special milling machines, as well as the difficult problem of supporting thin sections while machining. The etching technique has an added advantage of enabling the unwanted metal to be removed after forming to shape, which could not be done with the conventional machining technique.

It is to be expected that more developments of this sort will appear in the future, but it is not anticipated that these will prove a major factor to the machine tool industry.

Automatic Controls Spark Industry Growth

More than 50 percent of current plant construction in the United States is associated with need for more efficient and automatic production, according to Paul B. Wishart, president of Minneapolis-Honeywell Regulator Co. Such activity serves to emphasize the growth of automatic control into most industrial and scientific fields. Automatic control, for example, accounts for as much as 90 percent of the cost of some advanced missiles and pilotless aircraft.

Expansion of the automatic production operations is a further step in line with all technical progress or mechanization, he points out, which is only an effort to extend himself beyond his own limitations. "The power shovel is merely an extension of man's

arms and hands; telephone and radio are simply projected speech and hearing; power vehicles are simply better and easier means of locomotion. Similarly, automatic controls are a super-extension of his nervous system—being faster, more accurate, applicable to almost all his functions and completely automatic."

To date, industrial instruments are utilized in all of the 50 different classifications of American industry, both to reduce costs and to improve product quality. In some cases, processes are possible only because of their use. In the future, he predicts more and more control will be utilized in manufacturing operations.

AUTOMATIC ASSEMBLY of printed wire circuits

By T. W. Black
Assistant Editor

Use of printed wiring for small electrical circuits has eliminated numerous hand wiring and soldering operations. Further reductions in manufacturing costs have been made possible by the development of automatic machines for circuit assembly. The problems involved are essentially tool engineering problems, many of which have been solved with a considerable degree of success at the Military Products Division of IBM at Kingston, New York.

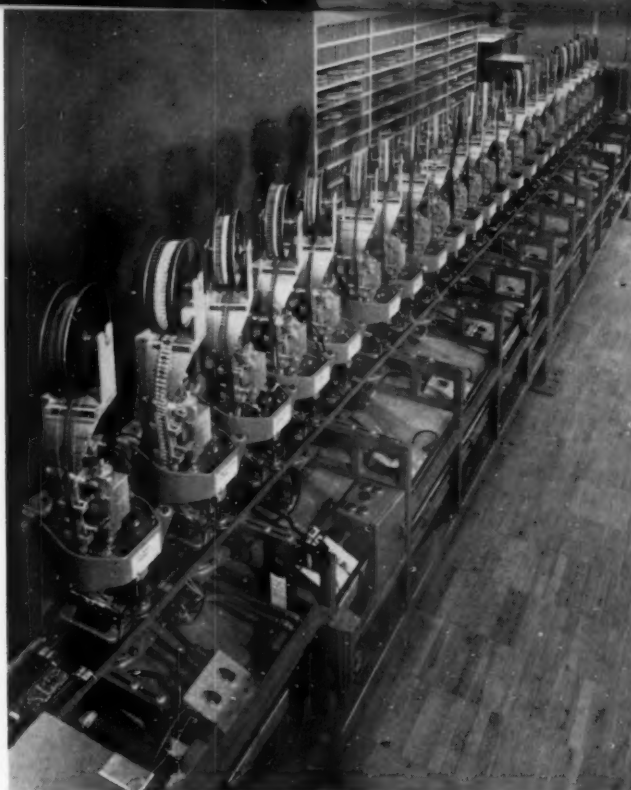


Fig. 1. Autofab machine. Each station inserts one component in a printed wiring card. Manual controls at each station permit individual adjustment in case of malfunction.

LARGE QUANTITIES of electrical circuits are required in the manufacture of electronic equipment. The circuits produced by IBM at Kingston consist of small die-cut fiber cards with wiring diagrams etched on both sides, to which components such as pulse transformers, resistors, and capacitors are assembled automatically. Key machine in the production system is the "Autofab," Fig. 1, which assembles components to the cards. Other automatic machines are used to prepare components for assembly, to insert the lugs or terminals used for electrical distribution to and from the card, and to perform the dip soldering operation which seals components in place. The end product of these operations, a completed circuit, is shown in Fig. 2.

Preparation of components for assembly consists of straightening the leads, cutting them to proper length for insertion in the card, crimping terminals onto the leads, and loading the components onto the reels used to feed the automatic assembly machine. These operations, Fig. 3, are performed at high rates of speed to keep pace with the productivity of the Autofab machine.

Lead Straightener: Straightening of the leads is an extremely important operation, since bent or crooked leads could result in malfunction of the

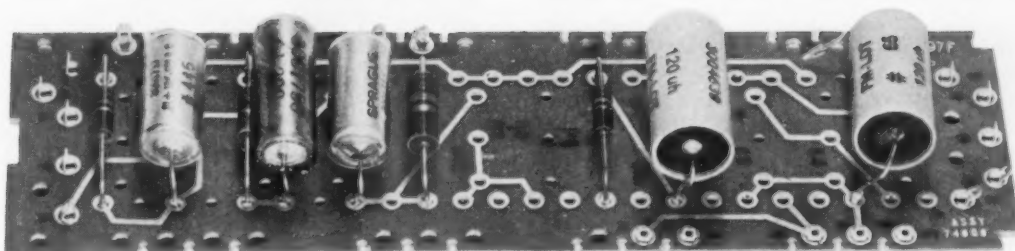
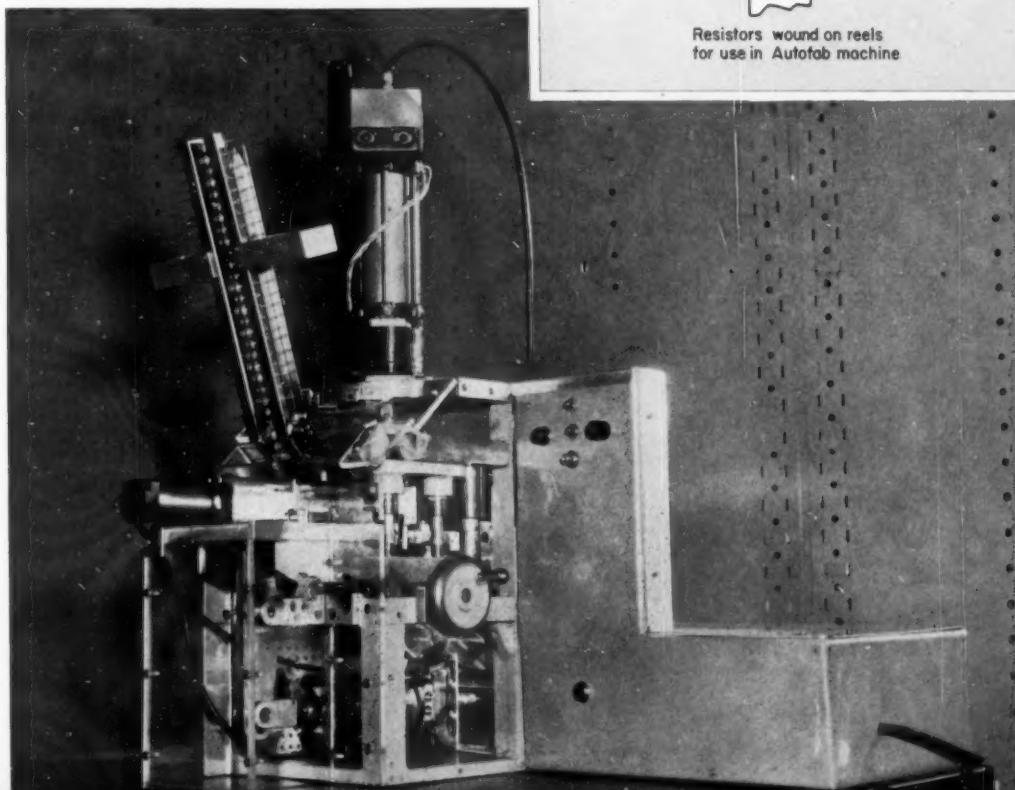
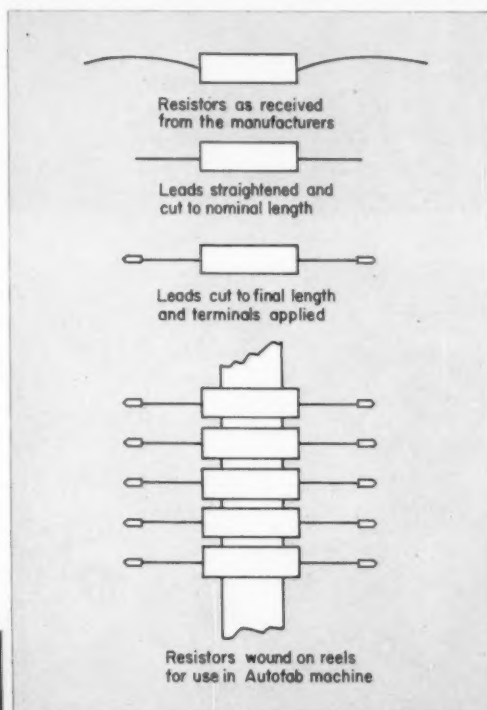


Fig. 2. (top) Electrical circuit after assembly of components. Soldering lugs can be seen near the left and right-hand edges of the printed wiring card.

Fig. 3. (center) Steps in the preparation of components before assembly to printed wiring card.

Fig. 4. (bottom) Automatic wire lead straightener. Components are fed through chute into die, which straightens leads and cuts them to nominal length to facilitate subsequent handling.

assembly machine. Essentially, the lead straightening device, Fig. 4, consists of a small die actuated by air cylinders. Components are fed from a gravity chute and are released individually onto the jaw of the die, Fig. 5. The anvil descends, straightening the wire in one plane. A straightening punch then moves in between the anvil and the jaw, straightening the wire in the second direction and simultaneously cutting the leads to nominal length. The anvil and punch then retract; another part is released into the jaw and the cycle is repeated. As green components are pushed onto the jaw, they push completed parts off the jaw into the unload chute.



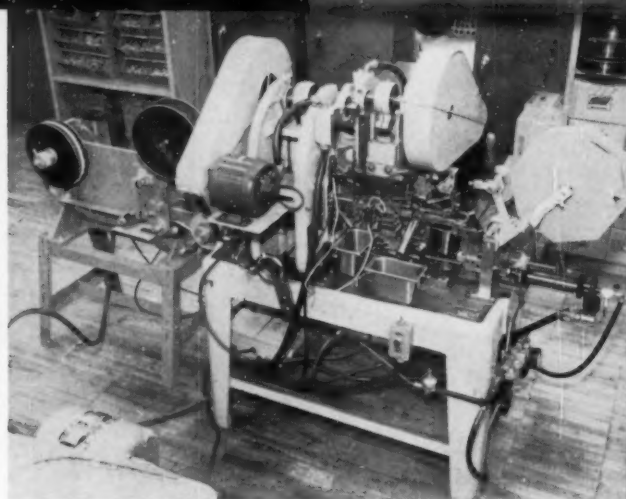
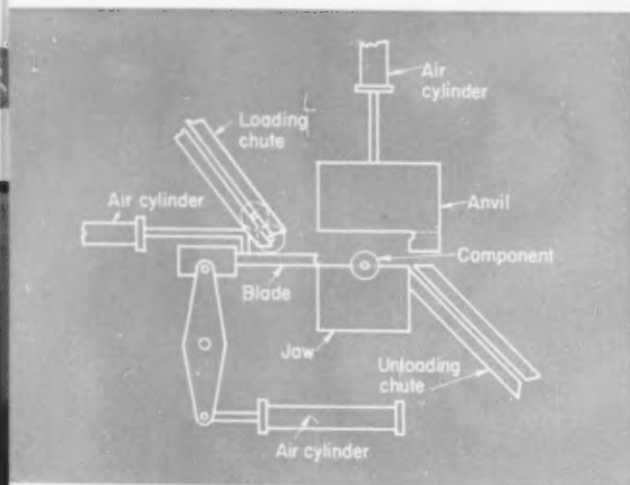


Fig. 5. (upper left) Automatic lead straightening die.

Fig. 6. (above) Autoprep machine applies terminals to each wire lead to facilitate assembly and insure a good joint.

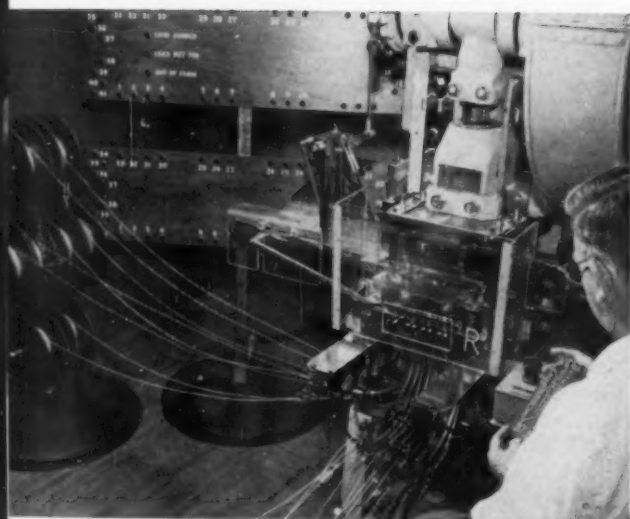
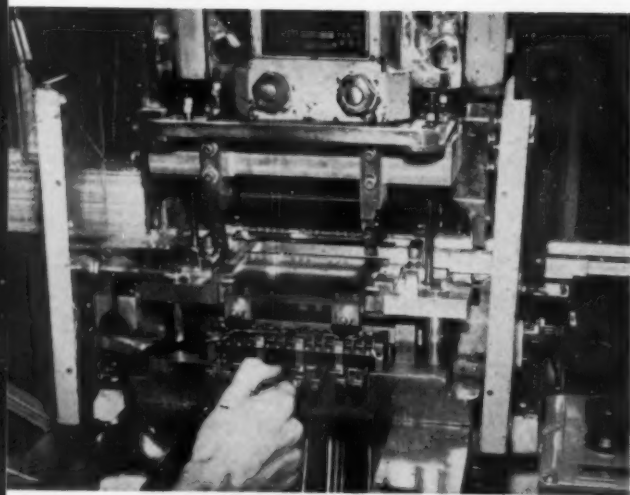


Fig. 7. (center left) Chains of lugs are fed into the die of the Autolug machine and automatically inserted into selected holes in the printed wiring card. Board at top of picture corresponds to printed card and lights indicate stations where malfunction occurs. Lights on bottom board show stations where insertions are being performed.

Fig. 8. (lower left) Operator adjusting feeding fingers on Autolug die. Each finger controls insertion of lugs in one station.



Application of Terminals: Terminals are applied to the leads in order to make a good mechanical fit between the leads and the holes in the printed card. It has been found that unsatisfactory soldered connections have been virtually eliminated through the use of the terminals since the solder rises and fills all open areas in the hole through capillary action. The tight mechanical fit between the terminal and the hole also facilitates handling of the completed assembly prior to soldering.

Terminal application is accomplished on a special machine, Fig. 6, called the "Autoprep." Components are fed into the machine manually or, preferably, on tape. A hitch type device carries the components between successive stations where leads are cut to length and terminals are crimped in place. The terminals themselves are fed into the machine in the form of a chain. As components leave the last crimping station, they come into contact with an adhesive on a single backed tape which is wound onto reels to hold components in position. The reels are used for the storage of completed components and to feed the automatic assembly machine.

Lug Insertion: From one to 41 soldering terminals can be automatically inserted in the printed cards in an automatic lug inserting die used in a small punch press, Fig. 7. There are 41 reels of

terminals located on the four sides of the die. These are fed into the die through tubes. Feeding fingers projecting from the sides of the die, *Fig. 8*, are set by the operator to control the number and location of the lugs required for a given circuit design. When an individual feeding finger is pulled to the "out" position, terminals are fed into the corresponding location in the die for insertion into the card. When the fingers are pushed to the "in" position, feeding does not take place. In setting up, the operator works from a simplified blueprint of the card. An inspection board with green lights corresponding to the 41 locations in which lugs can be inserted is located to the left of the press. When the operator pulls out one of the feeding fingers, the corresponding light on the board is turned on. This enables the operator to visually check his pattern of insertions against the blueprint.

Printed circuit cards are fed into the die from a hopper. Once the operator has set the feeding fingers, the entire operation of the press is automatic.

As the upper half of the die is raised, a card is fed into position for the insertion of lugs and the lugs are inserted. On the downstroke of the press, crimping and cutoff operations take place. Insertion of a new card from the hopper moves the completed card to an electrical inspection station where the locations of the lugs are checked automatically.

A second inspection board, identical to the one used to inspect the setup, indicates malfunctions in operation of the equipment. Precision limit switches,

located on each of the 41 tubes through which the lugs are fed to the die, open if a strip of lugs is pulled out of position. The press automatically stops and a red light flashes to indicate the location of the trouble. Separate red lights in the center of the board inform the operator if a card jams or the hopper is empty. The press is automatically stopped for either of these contingencies.

Assembly Machine: Following insertion of lugs, the cards are transported to the assembly operation. The machine for insertion of components into printed circuit cards—the "Autofab" machine—is capable of assembling from one to 24 components into individual cards at the rate of 1200 cards per hour. An eight-station turret, *Fig. 9*, is used to magazine feed the cards onto a chain conveyor which carries the cards under each of 24 inserting heads. The turret automatically indexes

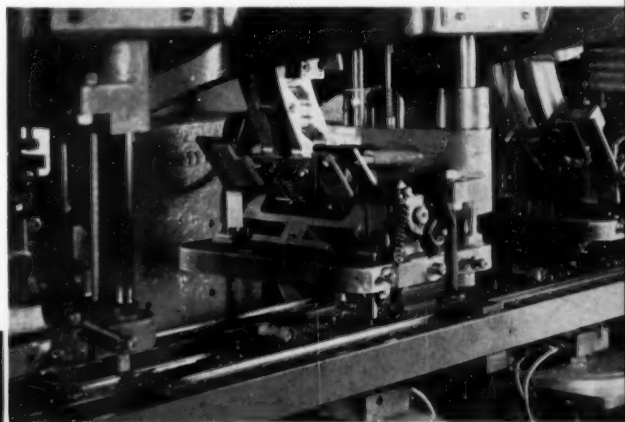
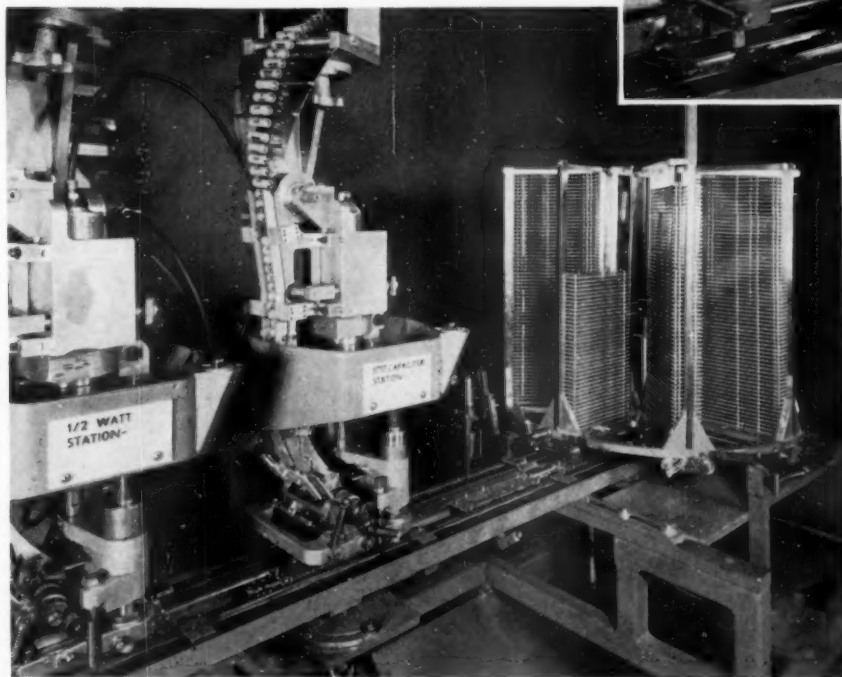


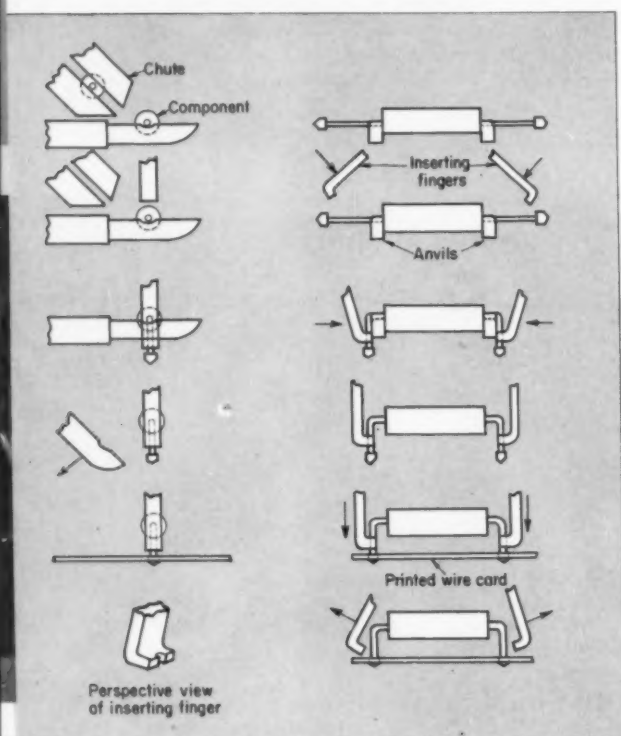
Fig. 9. (left) Eight-station turret feeds printed wiring cards to Autofab machine.

Fig. 10. (above) Head on Autofab machine feeds formed terminals of component into printed card.



when the supply of blanks in a station is exhausted, and stations can be loaded without stopping the machine.

Each head, *Fig. 10*, is standard, with the exception of the tools which transport, form and insert components. These tools are designed to accommodate specific sizes and type of components. Leads on the components have been straightened and cut to size, and terminals have been clinched to the ends of the leads as already described. The final operation on the leads—bending 90 deg—is performed by the tools on the inserting head.



In operation, the inserting head functions as follows: components from a tape reel are gravity fed down a chute and individually loaded onto two projecting arms or anvils, *Fig. 11*. Inserting fingers then descend and bend the leads down over the anvil ready to be inserted in the proper holes in the card. The inserting fingers grip the leads firmly and the anvil backs out of the way. The fingers descend and the component is inserted in the card. The fingers then open and return to the "wait" position. The anvil also swings back into position to receive a new component.

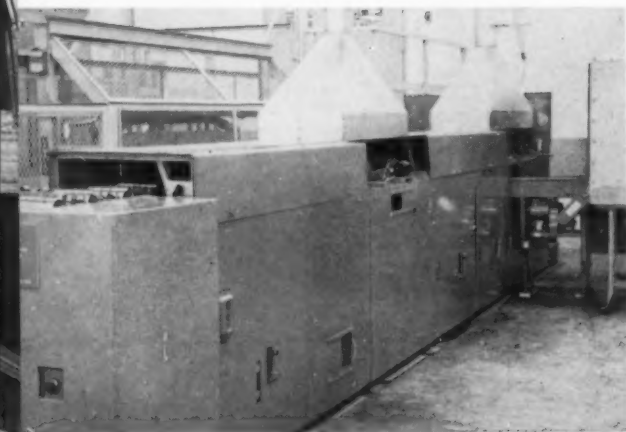
Use of tape reels for feeding components instead of the magazines originally used has resulted in a substantial cost savings. The reels are easy to handle and store, can be rapidly installed on the Autofab machine, contain many more components than the magazines and can be mechanically loaded.

Inspection devices are incorporated in each inserting station. Two open contacts are placed directly under the holes in the printed circuit that receives the leads of the component. If the inserted leads project through the board for the required distance, the open contacts are closed and the machine will recycle and index the card to the next inserting station. In the case of a faulty insertion, a red light flashes, enabling the operator to locate the station where the malfunction has occurred. Separate control panels are located adjacent to each inserting head to permit individual adjustments and tryout when necessary. Limit switches are built into the card stops at each station so that the head will not function if the card is not properly aligned.

Soldering: At the completion of the card assembly operation, cards are dip soldered with all components in place. Soldering is accomplished automatically at the rate of 1200 cards per hour in the "Autosol" machine, *Fig. 12*. The cards are carried through flux, preheating and dip soldering on a chain conveyor system. Dross is automatically skimmed from the solder by blades attached to the conveyor. The level of solder in the tank is kept constant by a device which inserts a precise length of solder wire in the tank each time a card is soldered in order to replace solder carried away by the cards. After soldering, the cards are released from the chain conveyor and drop onto a canvas belt conveyor which carries them to a final cleaning operation. Completed circuits are tested electronically.

Fig. 11. (upper left) Action of forming and inserting fingers of Autofab. Fingers form leads around anvil, which then is retracted and head descends, inserting leads in holes in printed card. Fingers then retract and anvil swings back to load position.

Fig. 12. (left) Circuits are carried through fluxing and dip soldering operations on an endless belt conveyor. This is the final operation on the circuit other than cleaning and inspection.



Grinding

Tap and Die Chasers

THREADING CHASERS must be chamfered on the leading edge, *Fig. 1*, providing a series of threaded teeth of varying depth. This allows the thread on the work to be cut in one pass. The longer the chamfer on the chasers, the better the finish on the workpiece. Long chamfers have the added advantage of placing less strain on the diehead or tap. Recommended angles of chamfer are shown in *TABLE 1*.

Milled-form radial type chasers should be sharpened by regrounding the chamfer only. Face thickness, *Fig. 1*, is critical and should not be changed. If it is necessary to regrind the chaser face, however, not more than 0.002 to 0.003 inch should be ground off. When the chamfer gets too long and the chaser will not thread up close enough to a shoulder, a step is ground on the chaser, *Fig. 2*, and the chamfer is reground.

The heel of the chamfer on the milled-form chasers should be slightly lower than the leading edge. When the chamfer is properly ground, *Fig. 3*, the root of the thread appears V-shaped, the vertex of the V being at the heel of the chaser.

Tapped-form chasers, sometimes called hobbled chasers, may be sharpened by regrounding the face

as well as the chamfer. As in the case of milled-form chasers, the heel of the chamfer should be slightly lower than the leading edge, *Fig. 4*.

Unless special fixtures and equipment are available, chamfers on chasers for solid, adjustable and collapsible taps should not be reground. Regardless of the type of chaser, all chasers in a set should be ground exactly alike on the same grinder setting. If chasers in a set are not ground uniformly, more load will be thrown on one chaser than another when cutting the thread on the workpiece, causing troubles such as taper, shaving and rough threads.

The amount and type of hook or snub on the chaser is determined by the composition of the material being threaded and by the type of thread. Types of hooks are shown in *Fig. 5*, and recommended angles are shown in *TABLE 2*. The lip hook grind is not recommended for shouldering or bottoming work. In such cases, the recommended angle is used but the lip hook grind is eliminated.

Even if the chaser is properly ground, threading troubles may occur due to the use of an improper lubricant for the material being threaded. Suggested lubricants are listed in *TABLE 2*.

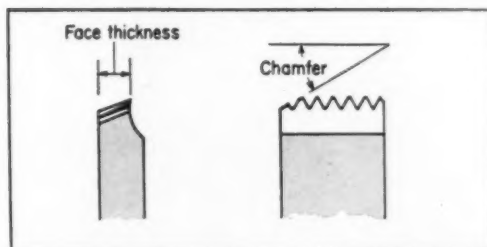


Fig. 1. Correct chamfer improves surface finish and chaser life. Face thickness on milled-form chasers should not be changed in grinding.

Table 1—Chamfer Angles

No. of Threads Chamfered	Angle of Chamfer (deg.)	
	USS, V, Whitworth Thread Forms	Acme and Similar Thread Forms
1	45	33
1½	33	22
2	22	15
3	15	

Data for this Reference Sheet and for the July Reference Sheet "Thread Chasing Speeds" furnished through cooperation of Chaso Tool Co., Inc., North Branch, Mich.

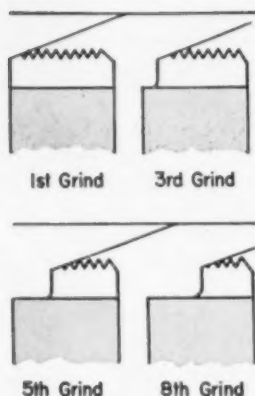


Fig. 2. Step in chaser facilitates threading close to a shoulder.

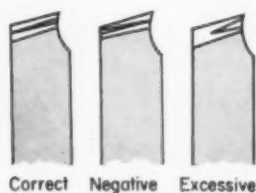


Fig. 3. Correctly and incorrectly ground milled-form chasers.

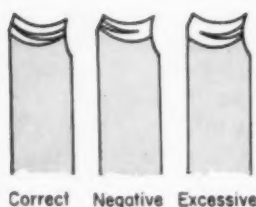


Fig. 4. Correctly and incorrectly ground tapped-form chasers.

Table 2—Chaser Face Grinding Chart

Material Being Threaded	Diehead Chasers		Tap Chasers		Suggested Lubricant for Chasing
	Straight Threads (deg)	Taper Threads (deg)	Straight Threads (deg)	Taper Threads (deg)	
Aluminum					
Cast and die cast	15 rad. hook	10 rad. hook	20 rad. hook	20 rad. hook	kerosene oil
Red and stamping	15 rad. hook	10 rad. hook	20 rad. hook	20 rad. hook	kerosene oil
Brass					
Bar	5 hook	straight	5 hook	5 hook	paraffin oil
Cast	5 snub	5 snub	5 hook	5 hook	dry
Forging and stamping	10 hook	5 hook	10 hook	10 hook	paraffin oil
Tubing and naval	10 hook	5 hook	10 hook	10 hook	paraffin oil
Bronze					
Bar	10 hook	5 hook	10 hook	10 hook	paraffin oil
Cast	straight	5 hook	5 hook	5 hook	dry
Cast aluminum	10 hook	5 hook	10 hook	10 hook	paraffin oil
Manganese	10 hook	5 hook	10 hook	10 hook	paraffin oil
Naval and phosphor	10 hook	5 hook	10 hook	10 hook	paraffin oil
Tubing	10 hook	5 hook	10 hook	10 hook	paraffin oil
Copper	15 rad. lip	10 rad. hook	20 lip hook	20 rad. hook	paraffin oil
Copper-Silicon	10 hook	5 hook	10 hook	10 hook	soluble oil
Monel metal	10 hook	5 hook	10 hook	10 hook	mineral oil
Nickel maxel	15 hook	10 hook	20 lip hook	15 rad. hook	mineral oil
Iron					
Cast	straight	straight	5 hook	5 hook	dry or soluble
Malleable and wrought	10 hook	5 hook	10 hook	10 hook	soluble oil
Silver (German)	10 hook	5 hook	10 hook	10 hook	paraffin oil
Steel					
Bess'm'r scr. stock	10 hook	5 hook	10 hook	10 hook	mineral lard, 20% lard
Cast	10 hook	5 hook	10 hook	10 hook	soluble oil
Carb. 1010-1035	10 hook	5 hook	10 hook	10 hook	mineral lard, 20% lard
1112-1340	10 hook	5 hook	10 hook	10 hook	mineral lard, 20% lard
1040-1095	15 hook	10 hook	20 lip hook	15 rad. hook	mineral lard, 20% lard
Mang. T1330-T1350	15 hook	10 hook	20 lip hook	15 rad. hook	suphinated oil
Chrome 5120-52100	15 hook	10 hook	20 lip hook	15 rad. hook	suphinated oil
Van. 6115-6195	15 hook	10 hook	20 lip hook	15 rad. hook	suphinated oil
Forging	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
Moly 4130-4820	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
Nickel 2014-2515	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
NiChrome 3115-3450	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
Nitalloy	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
Stainless #400	15 hook	10 hook	20 lip hook	15 rad. hook	lard oil & white lead
Stainless #300	10 hook	10 hook	20 lip hook	15 rad. hook	mineral lard, 20% lard
Stamping	10 hook	10 hook	20 lip hook	15 rad. hook	suphinated oil
Tool	15 hook	10 hook	20 lip hook	15 rad. hook	soluble oil
Tubing	10 hook	10 hook	20 lip hook	15 rad. hook	
Semicalcating	straight	straight	5 hook	5 hook	
Zinc die casting	15 rad. hook	10 rad. hook	20 rad. hook	20 rad. hook	soluble oil
Nonmetallics					
Celluloid	straight	straight	5 hook	5 hook	dry
Fiber	5 snub	5 snub	5 hook	5 hook	dry
Plastics (phenolic)	5 snub	5 snub	5 hook	5 hook	dry
Rubber	5 snub	5 snub	5 hook	5 hook	dry

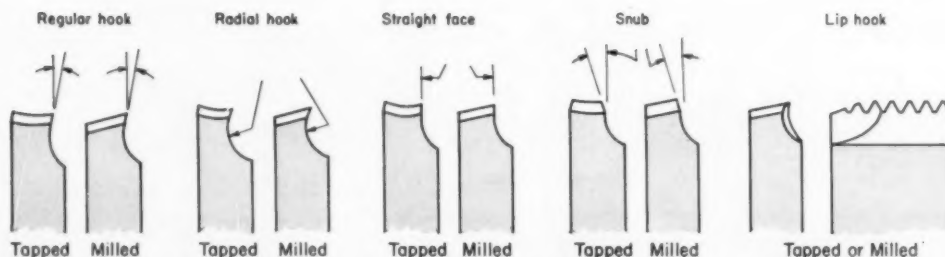


Fig. 5. Chaser face grinds. Lip hook grinds include first full tooth beyond chamfer.



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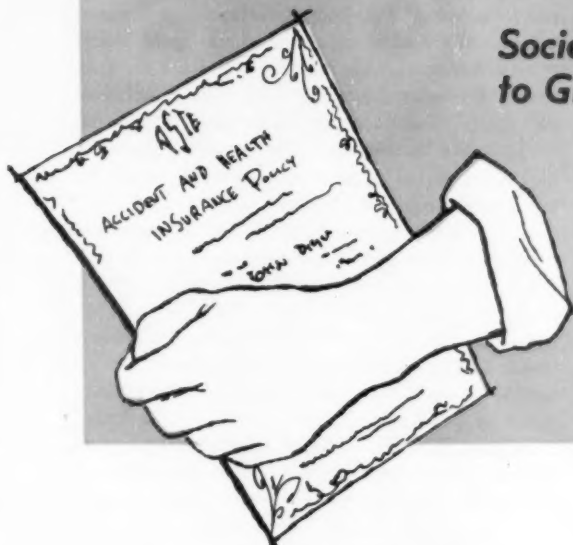
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ASTE Sponsors Income Protection

***Society Members Can Subscribe
to Group Insurance Plan***



Answering a long felt need voiced by Society leaders and after thorough investigation for a period of years, ASTE brings another service to its 35,000 members—income disability insurance.

Sickness or injury which keeps a man off his job no longer has to mean financial stress for ASTE members who subscribe to the Society's group insurance plan. They can be assured of regular income during these times of difficulty.

National delegates were asked at the 1956 Annual Meeting in Chicago to find out if their chapters would be interested in such insurance. Chapters responded so enthusiastically that the Society has gone ahead with the program.

Ordinarily, because such insurance is sold on an individual basis, the expense of selling and servicing policies and claims makes the cost prohibitive.

ASTE, however, because it is sponsoring a group insurance program, can offer broader coverage with higher benefits at a much lower cost. The buying power of ASTE and its many chapters and low cost of selling and administration provide outstanding features not even available in an ordinary individual policy at higher price.

Similar plans are offered by almost all medical and dental societies, bar associations, and many architectural and engineering societies.

The ASTE Plan aims at providing coverage as uniform as possible for *all* members and yet flexible

enough to meet the needs, incomes and age groups of a widely diversified Society.

Why Protect Income?

The familiar list of statistics revealing how many man-hours are lost every year through sickness and



injury seems nothing more than that, a list of figures which always pertain to someone else—"not me!"

Sooner or later, though, the law of averages catches up with some among us. We may get too close to machinery and injure a hand, trip on a stair and break an ankle, be attacked by an unnamed virus, or get involved in an automobile accident.

Any one of hundreds of circumstances can mean

a prolonged stay in a hospital plus extended recuperation at home.

A great many people carry hospitalization as well as surgical and medical benefits. While it is satisfying to know these out-of-the-ordinary expenses will be met, what of everyday living costs?

The grocer must be paid; the milkman comes around daily on his appointed rounds; house pay-



ments are due monthly; utility bills pile up regularly; and a host of other due statements arrive in almost every mail.

When unable to work, a good engineer may be carried on the payroll for a while because he's a valuable man. Yet how long can an employer afford to do this and still maintain a sound financial operation? Possibly a couple of weeks or maybe 90 days at the most.

Through the ASTE Plan, you can be paid up to \$100 weekly, when disabled because of illness, disease or accident, on or off the job. Also it will pay you up to \$10,000 for dismemberment due to accident, or pay your beneficiary in event of accidental death.

Who Is Eligible?

First of all, only members may subscribe. If 50 percent of the eligible members of any chapter enroll in the plan during the initial enrollment period, all applicants will be eligible for coverage as applied for even though some of them might be normally uninsurable.

Should enrollment in a given chapter be less than 50 percent but more than 40 percent, the underwriting company guarantees issuance of coverage to every applicant. In the case of impaired risks, however, benefits will be limited to \$50 weekly and/or subject to a 90-day waiting period.

When participation is less than 40 percent of chapter membership, the acceptance by the underwriters will be on a selective basis. Even this will allow members the advantages of liberal coverage at low cost to be found only in group protection.

All members under 70 years of age, actively engaged in their occupations in the U.S., its posses-

sions and Canada may apply under the ASTE Plan during the initial enrollment period. After that, enrollment will be limited to members under 60.

Advantages of the Plan

The ASTE Income Protection Plan has many advantages. An individual member's insurance cannot be terminated so long as membership is maintained and the plan remains in force—until retirement or upon reaching age 70.

Premium payments are waived after a period of six months' continuous total disability and benefits continue for the length of the disability up to the maximum period of payment provided under the terms of the contract.

In case of an oversight or if for any reason a member cannot make payment, thirty-one days of grace are allowed and coverage is automatically in force for the period.

House confinement is not required to collect benefits. They can be collected while you are up and around—as long as you cannot perform the duties of your occupation.

Sickness disabilities beginning after the effective date of your insurance are covered regardless of the date or origin of your ailment. Once the certificate is in force, it cannot be changed to eliminate coverage of an ailment.

Full benefits are payable regardless of any other insurance or other source of indemnity or income. Benefits are also Federal Income Tax free.

The ASTE Plan is twofold. Under Plan 1, if you are disabled because of illness and unable to work, you will be paid the weekly indemnity with the



first day of hospitalization, or the eighth day total disability, whichever occurs first, for two years (104 weeks). Under Plan 2, benefits begin on the 91st day of disability.

Under Plan 1, if you are disabled because of accidental injury and unable to work, you are paid the weekly indemnity beginning with the first day of total disability for a period of ten years (520 weeks). A weekly indemnity for partial disability, payable up to 13 weeks, beginning with the first day, is also part of Plan 1. In addition, actual medical expense up to one week's indemnity for a nondisabling injury is part of Plan 1. Under Plan 2, benefits do not begin until the 91st day of disability.

For instance, if your employer already provides some protection of this type, say covering you for 13 weeks, more or less, you would not want to receive benefits under the ASTE Plan on the first day of disability. The 90-day provision, costing less, would be much more practical.

On the other hand, you may think that \$25 a week would tide you along, whereas, someone else might want \$100 a week protection.

A reduced cost is available for ASTE members under age 35 with the understanding that they will pay the regular group rate after attaining age 35.

Minimum Indemnity for Specific Accident

When an injury results in any of the specified losses, including certain fractures and dislocations, benefits are payable for the period of total disability up to 10 years. However, in no event will the payments be made for less than the amount



stated in the schedule appearing in the policy.

For loss of life, limb, sight or hearing, lump sum payments are made in amounts from \$2,500 to \$10,000. This amount is always paid in addition to all other benefits under the plan and is payable if loss occurs within one year from the date of accident.

When you recover from an illness or accident and go back to work, if another disability occurs from the same or other causes, you will be eligible for full benefits again.

Continental Casualty Co. of Chicago is the underwriter for the ASTE Plan. Licensed in every state and in Canada, it has branches all over the country.

Administration for policyholders' service, premium collections, and claims will be handled through ASTE Group Insurance Administration, 2210 Park Ave., Detroit 1, Mich. Anyone who wishes additional information may write the same address.

Choose the Plan Which Best Fits Your Needs

	Class	Weekly Indemnity	Principal Sum	PLAN 1 PREMIUMS 1st Day Accident 8th Day Sickness		PLAN 2 PREMIUMS 91st Day Accident 91st Day Sickness	
				Annual	Semi-Annual	Annual	Semi-Annual
REGULAR RATES FOR MEMBERS AGE 35 AND OVER	<input type="checkbox"/> A	\$100.00	\$10,000	<input type="checkbox"/> \$167.00	<input type="checkbox"/> \$84.00	<input type="checkbox"/> \$102.00	<input type="checkbox"/> \$51.50
	<input type="checkbox"/> B	\$ 75.00	\$ 7,500	<input type="checkbox"/> \$125.25	<input type="checkbox"/> \$63.15	<input type="checkbox"/> \$ 76.50	<input type="checkbox"/> \$38.75
	<input type="checkbox"/> C	\$ 50.00	\$ 5,000	<input type="checkbox"/> \$ 83.50	<input type="checkbox"/> \$42.25	<input type="checkbox"/> \$ 51.00	<input type="checkbox"/> \$26.00
	<input type="checkbox"/> D	\$ 35.00	\$ 3,500	<input type="checkbox"/> \$ 58.45	<input type="checkbox"/> \$29.75	<input type="checkbox"/> \$ 35.70	<input type="checkbox"/> \$18.35
*RATES FOR MEMBERS UNDER AGE 35	<input type="checkbox"/> CJ	\$ 50.00	\$ 5,000	<input type="checkbox"/> \$ 71.00	<input type="checkbox"/> \$36.00	<input type="checkbox"/> \$ 43.35	<input type="checkbox"/> \$22.20
	<input type="checkbox"/> DJ	\$ 35.00	\$ 3,500	<input type="checkbox"/> \$ 49.70	<input type="checkbox"/> \$25.35	<input type="checkbox"/> \$ 30.35	<input type="checkbox"/> \$15.70

*AT ATTAINMENT OF AGE 35, REGULAR RATES APPLY

DURING THE INITIAL ENROLLMENT PERIOD:

Only Members under age 60, earning more than \$8500.00 annually may apply for Class A.

Only Members under age 60, earning more than \$6500.00 annually may apply for Class B.

Members under age 69 may apply for Class C or D.

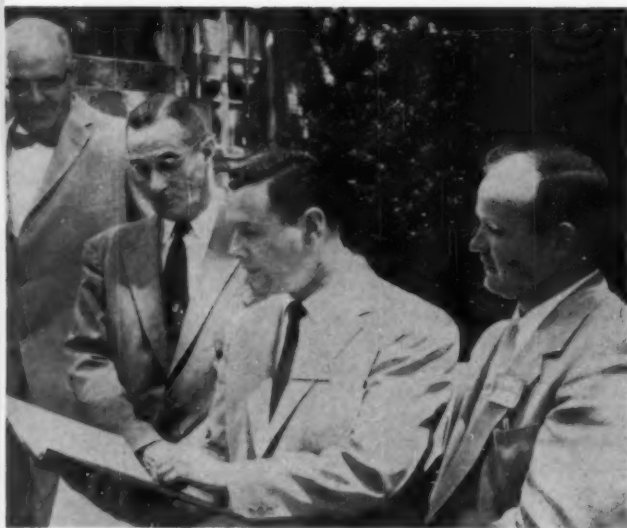
Members under age 35 may apply for Class CJ or DJ.

AFTER THE INITIAL ENROLLMENT PERIOD:

Only Members under age 60 may apply for coverage. After coverage is in force, it may be carried to age 70.



Relaxing between sessions while they look over the crowded conference program to see what's next on the agenda are Mr. McGinnis, Dr. Osborn and Mr. Alspach.



The workshop sessions are discussed by A. L. Knapp, vice president and manager of Pratt & Whitney Co.'s Machinery Div.; Mr. Kendall; Prof. Linsky; and Prof. B. W. Niebel, head of the University's Industrial Engineering Department.

A group of engineers clusters around demonstration of automatic vibratory feeder at the workshop directed by W. McKinsey, Jr., manager of Syntron's part handling equipment department.



AUTOMATION SEMINAR

at Pennsylvania State University

One hundred and eighty men assembled for the Automation Seminar sponsored by ASTE and NAM at Pennsylvania State University June 10-15, and at least 50 men interested in the seminar had to be turned away due to facility limitations.

Registrants from 15 states and Sweden, Norway and Canada, included product designers, manufacturing engineers, and industrial executives interested in learning both the technical and practical problems associated with the organization, planning, tooling, and operation of an automation system.

The program, conducted by the Industrial Engineering Department of the University was under the general chairmanship of Asst. Prof. of Industrial Engineering, Chester A. Linsky, and consisted each day of one general session in the morning, and six concurrent afternoon workshops followed by an evening session.

For those who wanted to try a hand at solving practical design and application problems, there were daily workshops where it was possible to gain firsthand working knowledge of automatic control design, process and assembly equipment, and other automatic production machines and facilities.

Among the speakers at the conference were ASTE

President Howard C. McMillen, Dr. Harry B. Osborn, Jr., 1955-56 president; P. H. Alspach of General Electric Co.; and Marshall G. Munce, NAM director and vice president, The York Corp.

Other outstanding topics of the conference included the session on "Methods Engineering Planning as a Service to Progressive Manufacturing" by J. O. McGinnis of Saginaw Valley chapter, supervisor of Methods Engineering of General Motors Institute; and Henry Roeber and Herman Melzer, both from Sylvania Electric Products, Inc., on "Planning and Designing Various Types of Automatic Manufacturing Equipment." Mr. Melzer is a member of Northwestern Pennsylvania chapter of ASTE.

A particularly stimulating session was "Labor Looks at Automation," led by Ted F. Silvey of the educational staff A.F.L.—C.I.O., and James X. Ryan, regional manager of NAM. During this period it was pointed out that engineers are going to make more and better jobs, more and better industries, more opportunities, and that management will take care of its people. Labor and management were in agreement that automation will meet the growing demands of our population.

George H. Kendall, Sr., president of the George H. Kendall Co. and member of Fairfield County chapter, points out a feature of a holding fixture for automatic assembly during his workshop on "Automatic Process and Assembly Equipment Design."



August 1956

Photographs by Lens-Art Photographers



Applied research speakers J. S. Kirkpatrick, left, vice president of research, and D. A. Van Becelaere, research engineer, both with Brooks and Perkins, Inc., took over typical parts that can be produced from magnesium, titanium and zirconium alloys.

It was back to school for these tool engineers entering Wayne State University's new Science Hall on their way to the many tooling and materials lectures.



Moderator Frank W. Wilson, technical director of ASTE, at left, talks over speeches with R. T. Thornton, center, assistant director of the manufacturing engineering office, Ford Motor Co., and member of ASTE's National Book Committee; and C. E. Beck, Jr., assistant manager of capital investment at Ford, before one of the management sessions.

Detroit's first Tooling and

A broiling sun and high humidity were unwelcome visitors at Detroit's first annual tooling and materials conference June 14 at Wayne State University's Science Hall.

More than 250 persons braved the weather to take part in the all-day session, which was sponsored by ASTE's Detroit chapter in cooperation with the Engineering Society of Detroit, Wayne's Management and Materials Center, ASM's Detroit chapter and the Detroit Board of Commerce.

Among out-of-town visitors attending the event was ASTE President Howard C. McMillen.

Members of Detroit chapter on the conference arrangements committee were Lenard B. Lovings, chapter chairman; Edward J. Novack, first vice chairman; Robert W. Reinhardt, secretary; Stanley B. Commer, editorial chairman; and Arthur E. Vollrath, program chairman. Grant S. Wilcox, Jr.



Dr. Spencer A. Larsen, center, director of Wayne's Materials Management Center, checks on last-minute conference plans with his assistant, George E. Demorest, at right, and Prof. Robert S. Jones of the Dept. of Industrial Engineering, who were also on the arrangements committee.



Speakers at the manufacturing sessions are, from left: Paul E. Brandt, director of engineering services, Reynolds Metals Co.; Edward R. Phelan, head of the graphic illustration department of Chrysler Corp.'s Missile Operation Div.; Russell Bearss of Chrysler's Engine Div.; and R. L. Sims, project supervisor, Milling Machine Controls.



Intently watching a demonstration of Sintox Corp. of America's Tool Post Dynamometer is a group of engineers. The "shirt-sleeve" weather did not deter them from touring the engineering shops in both "Old Main" and the new engineering building.

Materials Conference

and Stuart P. Hall represented the Engineering Society of Detroit.

The technical sessions, which were divided into four main groups, featured 18 guest speakers. Discussing basic research problems were W. E. Jones, manager of vacuum melted products engineering, Carboly Dept., General Electric Co.; Dr. R. L. Eisner, research scientist, Westinghouse Electric Co.; H. R. Lissner, head of Engineering Mechanics Dept., Wayne University; and D. O. Leaser, staff metallurgist and head of the materials section, Atomic Power Development Associates, Inc.

Among applied research speakers was H. E. Replogle, manager of Tool Steel Div., Universal-Cyclops Steel Co., while manufacturing was the topic of C. B. Sung, supervisor of mechanical development, Research Laboratories Div., Bendix Aviation Corp.

Management lecturers included Clyde T. Mooney, president of Engineering Service, Inc. of America; and L. P. Gajda, director of engineering at Snyder Tool and Engineering Co.

One of the evening banquet highlights was the presentation by Mr. Lovings of Detroit chapter scholarships of \$500 apiece to Don Sirvio of Detroit and William Dais of Armada. Mr. Sirvio enters Wayne in September and Mr. Dais is a sophomore at the University of Michigan.

Walker Cisler, president and general manager of Detroit Edison Co., gave the banquet address on "New Tooling—New Materials—New Power—New Detroit Gets Together."

To round out the crowded conference day, A. L. Boeghold, manager of research at General Motors Technical Center, gave his audience a preview of "Materials for the Automobile of the Future."

President McMillen Presents Charters to Two New Chapters



ASTE baby bottle, passed on to each new chapter by the previous one chartered, is bestowed on Raleigh-Durham Chairman Reilly by Society Staff Administrator M. J. Bunting. Applauding the act are President McMillen; Raleigh's Mayor F. Wheeler; Toastmaster E. M. Ketchie, Piedmont chairman; and Mrs. Ketchie.

Raleigh-Durham

Culminating 14 months of hard work, Raleigh-Durham chapter, formerly a subchapter of Piedmont, was officially added to the Society roster June 8.

Chairman John T. Reilly received the charter from President Howard C. McMillen. Other officers are: George Marshall, Sr., first vice chairman; Harry J. Prout, second vice chairman; Louis A. Jones, third vice chairman; William A. Teer, treasurer; Thomas G. Willis, secretary; and Clyde C. Shannon, delegate.

Guests at the chartering, which was also ladies' night, included two past chairmen of Piedmont chapter, Albert R. Fairchild and S. Jeffreys; Raleigh Chamber of Commerce President C. Campbell, and Harold Sapp of the Durham Chamber of Commerce.



President McMillen shows charter to officers of Lorain County chapter. From left they are: Henry C. Bothe, Jr., chairman; Carl Mourning, first vice chairman; Ben Metzger, second vice chairman; Bill Durning, secretary; and Warren Sturtevant, treasurer.

Lorain County

Lorain County chapter, ASTE's 134th, already numbering 137 members, was chartered June 20 by President Howard C. McMillen.

Other guests were National Secretary William Moreland; National Director Andrew B. Clark; Frank Flannery of the National Membership Committee; Staff Administrator Marvin J. Bunting; and three mayors: Grant Keys of Elyria, John Jaworski of Lorain and Jack Koontz of Amherst.

Special recognition was given Carl Mourning, Samuel Rosen, Henry Libicki, Andrew Cirbus of the National Finance Committee and Ben Metzger for laying the groundwork for the new chapter.

Guest speaker was Don Hodgkins, president of Leadership Training Institute of Cleveland.

Greater Lancaster Seminar Deals with Engineer Shortage

A seminar entitled "Where will we acquire our future engineers and technicians" sponsored by Greater Lancaster was held June 9, at Stevens Trade School. John Stauffer, superintendent of Stevens Trade School, and Theodore Morrison, chapter chairman, delivered the welcoming addresses to seminar participants, including 25 training directors from industrial plants in the area.

Talks were given pointing up the general areas of discussion on industry's needs for engineers and technicians by V. L. Van Horn, Jr., industrial engineer, Armstrong Cork Co.; Robert McCord, director of extension instructors, Pennsylvania State University, and by Harry E. Medsger of Medsger Design Service.

Following the main speakers, small discussion groups were formed, from which the following ideas resulted: mechanical and electrical technicians, draftsmen, and designers are most needed; basic technical science and math subjects should be offered in high schools; there should be recognition, prestige and commensurate rates of pay; a community group could be organized to subsidize the cost of students whose companies do not already offer them the opportunity of additional study; classroom subject presentation was preferred for basic theory study; qualified instructors are essential; and it was felt that better counselling should be provided in junior high school and that a community group should be organized to promote interest in technical and engineering jobs.

The chapter concluded that annual seminars of this type may have a practical effect in helping to solve the acute engineering shortage. —Harry Medsger



GREATER LANCASTER—Recent speakers were Ben Kuresman, left, executive vice president of Precision Flexopress Co., and William Kane, vice president of sales, United Sound & Signal Co. Mr. Kane's talk was part of the chapter's "Salute to Industry" series.

Lansing Meeting Hears Edward Kibbitt

Edward Kibbitt, manager of field sales of tools for The Carborundum Co.'s Stupakoff Div., spoke to 73 members of Lansing chapter on June 11.

The subject of his talk was "Stupalox," a new high-strength, oxide-base metal-cutting tool. He explained that it is an oxide exhibiting no build-up on the cutting edge and no adjacent cratering.

—R. J. Krumrie

Little Rock Tours Plant

At Little Rock chapter's June 14 meeting Mr. Horst, chief engineer of Westinghouse Co.'s Lamp Div., gave a short talk on the plant's operations. The group then adjourned to the plant where Mr. Horst conducted the tour.

—M. Harden

Janet Lofting Joins Tool Engineer Staff

Janet Lofting has been appointed assistant news editor by John W. Greve, editor of *THE TOOL ENGINEER*. Mrs. Lofting, who was graduated from Syracuse University and did post-graduate work at Radcliffe College, was formerly associated with the Institute of Radio Engineers in New York City in the capacity of editorial assistant for their various technical publications. Prior to joining the IRE, Mrs. Lofting was on the employee publications staff of Godfrey L. Cabot, Inc., industrial chemical manufacturers in Boston, Mass.



In her new position with the news section, she will cover both chapter and national activities of ASTE.

Binghamton Chapter Hears G. F. Grey

Binghamton chapter's topic for the June meeting was "Weld Fasteners in Modern Day Production" given by G. F. Grey of the Ohio Nut and Bolt Co.

Mr. Grey's interesting talk, augmented by colored slides and a display, illustrated the various types of fasteners and fittings used in modern industry, the methods used in spot welding and resistance welding of these fasteners, and their application.

—Glyn Williams

E. F. Borro Addresses Fond du Lac Meeting

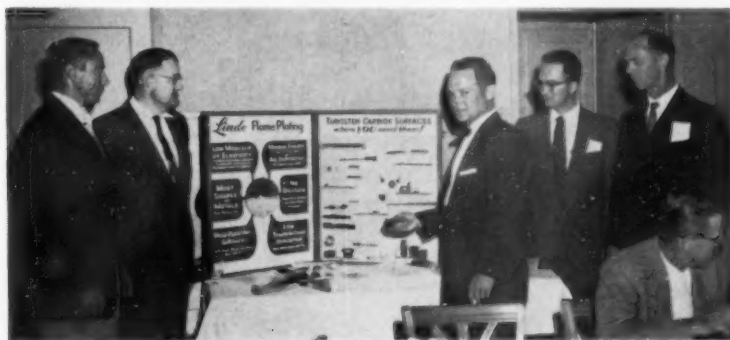
"Phenolic Molding Techniques" was the subject covered June 8 at Fond du Lac's meeting at the Art's 151 Club. Edward F. Borro of the Durex Plastic Div., Hooker Electro-Chemical Co., addressed the group.

Guests were R. N. Thomsen, chief engineer, and J. T. Harrington, project engineer, both of the Aluminum Specialty Co., Manitowoc, Wis.

Mr. Borro discussed the uses of plastic material in construction of tooling, casting resins used to make form dies, and mold and fixture design for plastic production. Slides were shown of tooling in plastics.

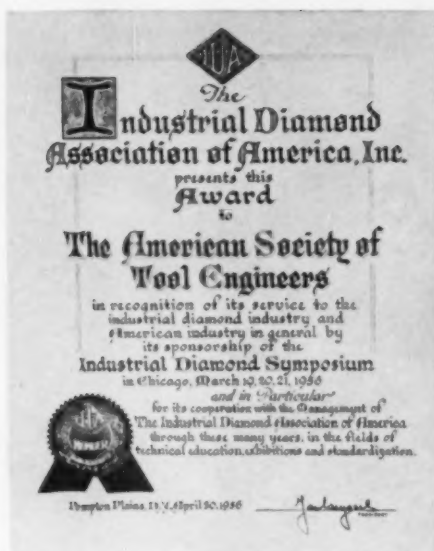
The first plastic molding process was described, as well as the various types of molds used in molding plastics.

—Christ S. Stelios



LOS ANGELES—At the Los Angeles meeting, R. O. Wyland of Linde Air Products presented sound-slides and gave a talk on the subject of "Flame Plating," the properties of the tungsten carbide coating and a description of production applications.

—Gene Grahn



ASTE was presented a special award by the Industrial Diamond Association of America, Inc., on June 22. ASTE was given the award "in recognition of its service to the industrial diamond industry and American industry in general by its sponsorship of the Industrial Diamond Symposium in Chi-

cago, March 19-21, 1956, and in particular for its cooperation with the management of IDA, in the fields of technical education, exhibitions and standardization." Harry E. Conrad, ASTE executive secretary, accepts the award on behalf of the Society from Jan Tacyaerts, right, president of IDA.

Diamond Symposium Papers Can Be Ordered

A complete set of coordinated technical papers on shaped diamond tools, all presented at the Industrial Diamond Symposium in Chicago, are now available. The package includes 12 technical papers by world-renowned authorities in the diamond industry, bound in a leatherette library edition. Copies of this up-to-the-minute data are available to members at \$2, or to nonmembers for \$4. Write to the American Society of Tool Engineers, Shaped Diamond Tool Symposium, 10700 Puritan Ave., Detroit 38, Mich.

Radio Tube Plant Visited By Merrimack Valley

Charles Coffin, plant manager of the C.B.S. Hytron plant at Danvers, led 96 members of Merrimack Valley chapter on an exceptionally interesting tour of its operations.

The most modern plant of its kind for manufacturing radio tubes, it opened in 1952 and employs 2,200 people (85% of whom are women) who produce 100,000 miniature radio tubes each day. —Leighton L. Reynolds

Nebraska Members Hear of Automation Concepts

At Nebraska chapter's May meeting the technical speaker, J. J. Mudd, division sales manager of The Bellows Co., was introduced by Ray Miller of Kansas City chapter. Mr. Mudd outlined the concept of automation held by the majority of companies, which think of it as combining operations rather than as producing the product as a whole.

A movie was shown which traced the development of the first air motor and its varied applications.

Alternate Delegate Forest Conover reported on the ASTE National Convention, and Paul Wahlund of Des Moines chapter invited members to attend the Solar Aircraft tour on June 20.

—Walter Larson



ALFRED STATE TECH—New officers installed at Alfred State Tech were from left: John Leland, second vice chairman; Don Kuarnstrom, first vice chairman; Kitty Hoehn, secretary; Ken Cook, chairman; and Howard Jones, treasurer. —Kitty Hoehn



RICHMOND—Charlie Clark, Sheffield engineer, points to the cutting tools on an automatic deburring machine, during Richmond's recent visit to the Sheffield Corp.

—Lawrence Liebert

Chautauqua-Warren Group Tour Plywood Plant

Ninety members of Chautauqua-Warren chapter made a tour which was arranged by Harry R. Carlson of the Pearl City Plywood Corp., a division of Jamestown Veneer and Plywood Corp. Starting with the log soaking pit, the group went on to observe each step in the company's manufacturing of solid core plywood and special contoured forms.

At the May chapter meeting, W. H. Lesemann, sales engineer of the Elox Corp., lectured and showed a movie on tooling with Elox electrical discharge machines.

Some of the uses which were covered were grinding with brass wheels, die sinking and threading. He stressed that the material to be cut must be an electrical conductor. —W. N. Carlson



LACROSSE—Looking over the program at bosses night meeting on May 22 are Chairman J. W. Hopkins; Al Graw, president, Randall Graw Co.; Al Zischke, vice president, Northern Engraving; R. Denzer, president, LaCrosse Cooler Co.; Francis Duffy, president and works manager, Trailer Co.; John Cantwell, works manager, Trane Co.; F. Pappenfus, works manager, Allis Chalmers Mfg. Co.; William Funk, chairman of the board, Trailer Co.; and L. W. White, owner, L. W. White Co. Main guest speaker was Birger L. Johnson, chief research metallurgist of Latrobe Steel Co. Fifty-six attended at the Commodore Club.

—B. T. Hanson



MUSKEGON—President Howard C. McMillen strikes a humorous note during his talk on "Management Challenges the Engineer" at executive night June 12. Listening appreciatively are Willard Bierma, program chairman; Toastmaster R. J. Mason, secretary-manager of Muskegon Mfg. Assn.; Vern Nephew, chapter chairman; and Dr. Allen Umbreit, director of Muskegon Community College, who discussed Muskegon's contribution to industry in training future engineers.

—Jack Jilek

Selection of Steels Is Albuquerque Topic

C. P. McShane, metallurgist of Crucible Steel Co. of America, addressed Albuquerque chapter members on "Selection and Heat Treatment of Steels" at the Hilton Hotel.

The chemical composition of various types of tool steels and the effect of heat treatment on the microstructure of the oil, air, and water-hardening grades were described and slides of related charts were shown.

Guests at the meeting were D. P. Carr of the Los Angeles office and Mr. Parker of the Denver office of Crucible Steel Co.

—H. E. Anderson

W. H. Lesemann Addresses Mohawk Valley Chapter

A technical session featuring a color film of the equipment and processes of metal removal based on the electrical discharge principle was conducted by W. H. Lesemann of Elox Corp. for 30 Mohawk Valley chapter members.

A question and answer period followed Mr. Lesemann's talk.

—Lloyd C. Schafer

Massachusetts Group Hears H. I. Dixon

At the May 15 meeting of South-eastern Massachusetts chapter, Harrison I. Dixon, president of the Metallurgical Products Co. of Brookline, addressed 96 members on the subject of "Frozen Mercury, Lost Wax and Permanent Mold Casting." Colored slides were used to illustrate the informative talk.

—Edward L. LaBroad



ROCKFORD—A suspicious comparison of golf scores seems to be going on among Meritt Schrock, Walt Franzen, Whittie Lehto and Larry Geiger at Rockford's playday at Forest Hills County Club. Well over 300 members and guests took part in the annual event, which also featured rod and reel casting and dart throwing competitions.

—Larry Geiger

ASTE Outings Flourish During June

Golf, horseshoe pitching, casting, softball, corksball—these and many other outdoor activities highlighted the annual chapter outings and picnics during June. Hundreds of prizes were given out, for everything from dart throwing to "most honest golfer." A roundup of ASTE summer activities as reported by editorial chairmen follows:

Chicago's golf stag on June 2 attracted 150 members who played golf at Silver Lakes Country Club in Orland Park, followed by dinner and an entertaining floor show.

A crowd of 150 attended Columbus chapter's stag picnic, which was under the direction of Howard Volz, who doubled as master of ceremonies. Ideal weather helped set the stage for the best picnic ever, according to all reports.

A smorgasbord dinner followed the sports program at Chautauqua-Warren's stag picnic at Spencer's Farm. Howard Knobloch, Nolan Hodge and Maurice Anderson tied in the special events tournament, with rain preventing an elimination contest. Rain also stopped the softball game between Warren County and Chautauqua County, which had to be called with the score tied at two-all.

Picnic committee members were Leslie Beau Jean, chairman; Donald Johnston, Denny Leonard and Donald Curtis, refreshments; Richard Freeman and Maurice Anderson, golf; Wesley Broadhead and Robert Putnam, horseshoes; Larry Green, Al Rogerson and Edward Freeman, softball; Harry Carlson and Howard Knobloch, special

events; E. W. Garrison and Kermit White, prizes; C. D. Seekins and Gordon Aldrich, tickets; Herbert Cave and Robert Wilson, drawing.

More than 230 members of Hamilton District chapter turned out for their fifteenth annual field day June 14 at Glendale Golf and Country Club, with golf, horseshoes and putting on the program. A set of golf clubs was won by Bill Beck and an electric drill kit by Jim Stoddard.

Low gross golf awards went to S. Balanda, Mr. Povlitz, Leo Kempa, Dick Ellis, Dillon Southwick and F. Belowitz, while H. Vollick and W. Kreuger were hidden score winners. Gord Hall was acclaimed most honest golfer, and putting honors went to Cy Barlow and George Watts. The team of S. Panessa and W. Demars won the horseshoe pitching contest, with J. Lentz and R. Brisebois in second place.

Indianapolis members, 250 strong, managed to crowd golf and casting tournaments and a horseshoe pitching contest, topped off by a chicken dinner, into their all-day picnic June 2 at Forest Park, Noblesville.

Aided by a warm sunny day, Racine's spring frolic drew more than 300 members and guests to Liggetts' Palm Gar-

dens at Brown's Lake. Many golfers tried their luck on the Brown's Lake golf course. An excellent group of vaudeville acts and a variety of card games after dinner rounded out the busy day.

Corksball, softball, horseshoe pitching and a "loot bag" were among the activities at St. Louis chapter's nineteenth annual stag picnic June 23 at Koehler Acres. About 375 members joined in the heated sports competitions, working up fine appetites for the menu of baked beef and ham with all the trimmings.

Little Rhody chapter rounded out a very successful year of activities with a dinner dance for members and friends at Franklin Country Club, preceded by a family-style chicken dinner.

Automation Topic at San Fernando Valley

R. T. Clark of General Electric Co. gave a talk on "Progressive Mechanization Automation" at the June 6 meeting of San Fernando Valley. Mr. Clark stated that automation raises productivity, improves workers' skills, improves quality, expands capacity, and cuts costs. The process of making, inspecting, assembling, testing, and packaging, he stresses, is done automatically, after which automatic control and handling complete the job.

—A. J. Soares



CHAUTAUQUA-WARREN — Chapter Chairman Cleon L. Douglas demonstrates the technique that won him first place in the golf tournament. Watching closely to pick up pointers is Runner-Up Richard Freeman. Not pictured is Tony DeMambro, who tied for second place.

—Walter Carlson

Peoria Hears Lecture on Variables in Tapping

"Variables in Tapping" was the subject of the talk Walter Marek, field engineer for Threadwell Tap Co., gave before the Peoria chapter June 1. Supplementing the talk was a movie entitled "Basic Taps, Terms, and Terminology."

Four new members and one student have been added to the Peoria chapter: John I. Ross, Jr., Leroy L. Cleveland, Joseph G. Ricca, Thomas A. Hancock, and student Richard G. Swift.

—G. Davison



SANTA CLARA VALLEY—Guest Speaker C. W. Tydeman, owner of Tydeman Machine Works, Inc., Redwood City, Calif., illustrates a point for Chairman William T. Wright. Mr. Tydeman's company was given the first affiliate membership in Santa Clara Valley chapter. Films showing the development of the atomic bomb and use of atomic energy by industry were shown. More than 60 members attended the June 19 meeting at The Old Plantation.

—William H. Forbes



GRAND RIVER VALLEY—Among dignitaries at Grand River Valley's annual ladies night meeting were these chapter officers, each of whom is standing behind his wife. From left they are: P. G. Bowman, second vice chairman; G. M. Dilly, first vice chairman; Clayt Henderson, chairman; R. L. Robertson, third vice chairman; J. G. Johnstone, secretary; and W. C. Little, treasurer. During the evening Chairman Henderson presented Immediate Past Chairman Joe Strite with his past chairman's pin.

—Grant S. Alpine



LONG BEACH—Panel members at a second chapter meeting are, from left: Robert M. Bartmess, optical tool engineer, Tool Research Co.; James M. Stolz, owner of Opto Engineering Co.; Ralph L. Hamilton, optical tool engineer, Lockheed Aircraft Corp.; and Kenneth M. Wilson, optical tool engineer, Douglas Aircraft Co. —Dan Welty

Ladies Night At Williamsport

Eighty-two members and their guests attended Williamsport chapter's ladies' night at the Milton Country Club. The program included dinner, dancing, and a talk by Tom Donovan, past national director of ASTE, who presented each of the ladies with a gift.

The chapter's executive committee is planning to establish an engineering section at Williamsport's James V. Brown library.

—Forrest Johnston

Surface Roughness Is Phoenix Topic

Clifford Commefort of the Paul B. Slater Co. gave a talk on "Surface Roughness, Waviness and Lay" to the Phoenix chapter June 11. He stressed the importance of standardizing equipment so that a universal reading can be obtained and explained the meaning of the numbers pertaining to surface finish symbols.

Mr. Commefort demonstrated a surface roughness instrument and discussed the effect of surface finish on machine parts and its relation to wear. At the conclusion of the meeting, members were able to try their own skill in reading the calibrations.

—John Hamay

St. Louis Hears Talk on Model Trimmer Machine

Sales manager and development engineer for the Model Trimmer, Inc., John Gall spoke to 150 members of the St. Louis chapter on June 7. Subject of his talk was "The Development and Applications of the Model Trimmer Machine." Members were able to observe many samples of jobs performed on the machine, as Mr. Gall had a working table size scale model on exhibit. An example of what the machine could do was afforded members when it performed a complex trimming and side punching operation on a small aluminum cup which had previously been drawn on a deep draw die.

—W. A. Schublein, Jr.

New Yorkers Hold Fourth

Tool Engineers' Day

A proclamation by the mayor of the City of New York declared May 7th as the fourth annual Tool Engineers' Day. Julius Schoen, president of Arista Design and Process Corp., was chairman of the event which was sponsored by the Greater New York chapter.

In his proclamation Mayor Wagner pointed out that "The tool engineering profession has contributed greatly to our prosperity and high standards of living, and to the production of the various machines and products which the American public now requires and considers necessary to our way of life" and is "a major factor in maintaining that ready strength which is the free world's sole deterrent to the threat of aggression."

Governor Averell Harriman, although unable to attend, sent his congratulations to the tool engineers for their many achievements.

Plant tours were first on the agenda for the all-day meeting, followed by a lecture, social hour, banquet and speakers.

The tours included Brooklyn Navy Yard; the Ford Motor Co. factory at Mahwah, N. J.; Merrill Bros., Maspeth, N. Y.; and the Tube Reducing Corp.

At the lecture meeting C. B. DeVlieg, president of DeVlieg Machine Co., spoke on "New Arts in Jigless Boring." He described current and new developments in precision boring and application to its field of uses.

Kirke W. Connor, president of the Micromatic Hone Corp., was the speaker at the banquet held in the Terrace Room at the Hotel New Yorker. The subject of his talk was "The Tool Engineer in Our Expanding Economy."

Prof. Merrill Flood of Columbia University's Industrial and Management Engineering Department was toastmaster.

A citation for his outstanding contribution in the field of engineering was presented to Prof. Herbert F. Roemmele, dean of students and director of industrial and alumni relations of the Cooper Union, Cooper Square, N. Y.

He discussed the need for a broader scope in engineering education including more study in human relations and additional specialized subjects, enabling engineers to enter all phases of today's expanding opportunities. He also pointed out industry's responsibility for financing colleges to help attain this goal.

—Fred W. Bechtold

Past President W. B. Peirce Dies

William Bradford Peirce, national president of ASTE in 1947-48, died of a heart attack on July 4. He was 78.

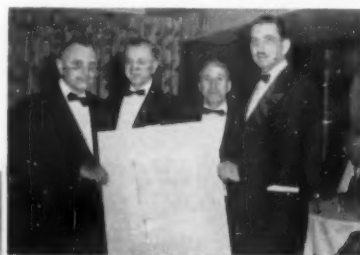
Prior to his retirement in 1947, Mr. Peirce had been vice president of research and development for Flannery Bolt Co. of Bridgeville, Pa. He joined the company in 1934 as works manager with full responsibility for all manufacturing. Mr. Peirce had a long and impressive record of service to ASTE, both at the chapter and national levels.

Elected chairman of the Pittsburgh chapter in 1940, Mr. Peirce also served coincidentally as ASTE national director for seven terms, from 1940-47. In addition, he was chairman of the National Membership Committee for two terms, from 1942-44.

A Life Member of the Society, he was a registered professional engineer, a member of the Engineering Society of Western Pennsylvania and of ASME. Mr. Peirce was also active in civic and community affairs.



At right, the mayor's proclamation designating May 7 as Tool Engineers' Day is proudly displayed by William F. Reber, Greater New York chairman; National Treasurer John X. Ryneska; Julius Schoen, chairman of the day's activities; and Prof. Merrill Flood of Columbia University, toastmaster. Below is the banquet head table and some of the 330 tool engineers who attended the event.



coming ASTE meetings

National

NATIONAL EDUCATION COMMITTEE—
Aug. 10, Milwaukee.

SEMIANNUAL MEETING—of the National
ASTE Board of Directors, Oct. 25-26.
The Greenbrier, White Sulphur
Springs, W. Va.

ASTE 25th Annual Meeting will be held
March 25 through 27, 1957, at Hous-
ton, Texas.



Members of the Rocky Mountain Chapters Conference pose for their official portrait after a successful session of discussing problems common to all chapters.

Chapter

DETROIT—August 11, Glen Oaks. An-
nual golf stag.

GOLDEN GATE—Aug. 21. Tour planned.

GRANITE STATE—Aug. 18. Annual out-
ing. Golf at Farmington Country
Club, games, field events, clam and
lobster dinner on Cocheco Valley
Assn. grounds.

LONG BEACH—Aug. 17, The Petroleum
Club. Annual "social."

LOS ANGELES—Aug. 9, Scully's, "Ceram-
ic Tooling, Tooling of the Future."

MUNCIE—Aug. 3, Heekin Park Cabin.
Annual stag picnic.

PEORIA—Aug. 19, Miller Park, Barton-
ville, Ill. Annual ASTE picnic.

SAN FERNANDO VALLEY—Aug. 8, Hody's
Restaurant, North Hollywood. Ladies
night.

SYRACUSE—Aug. 25, Hinenwadels Grove,
North Syracuse. Annual clambake.

Rocky Mountain Chapters Confer

The Rocky Mountain Chapters Con-
ference, attended by six ASTE chapters,
was held May 19 in Durango, Colo.
Represented were: Albuquerque, Den-
ver, Los Alamos, Phoenix, Salt Lake
City and Tuscon chapters.

On the agenda were program plan-
ning, membership and finance, stand-
ards review and educational planning
and recognition.

At the opening meeting, presided
over by P. D. Colburn of Phoenix, mem-
bers heard Leslie C. Seager, newly
elected national director; Ralph Chris-
sie, of the National Membership Com-
mittee; and J. R. Matthew of the Na-
tional Program Committee.

Mr. Seager explained the problems
involved in getting colleges to give tool
engineering courses, pointing out that

Utah State Agricultural College was the
first in the country to offer a degree in
it. He added that Westminster College
in Salt Lake City also teaches tool en-
gineering now.

The conference then divided into two
sections. One, with Mr. Matthew as
chairman, discussed how to improve
program planning; the other, under the
leadership of B. S. Boss, Los Alamos
chapter, talked over membership and
finance suggestions.

After lunch at the Strater Hotel,
which was provided through the cour-
tesy of Phoenix chapter, the conferees
again split into two groups.

Standards review was up for discus-
sion in the section led by F. J. Geoffroy
of the National Standards Committee,
while W. P. Paxton, second vice chair-
man of Salt Lake City, headed the
group discussing tool engineering
courses in schools and how to obtain
greater recognition for tool engineering.

H. R. Hanen, Albuquerque chairman,
was summary chairman, and J. Clifford
Ford, second vice chairman of Phoenix
chapter, will head the planning com-
mittee for next year's conference.

—John Hamay



LONG ISLAND—Henry Viscardi, president of Abilities, Inc., which is the famed
corporation of physically handicapped employees, was presented with a bust of
himself sculptured by Edward Howell. Shown after the presentation are: Chair-
man John C. Hatter, Sara T. Moxley, Edward Howell, Henry Viscardi, George J.
McLaughlin, and Robert W. Bradshaw.

—Robert W. Bradshaw

Syracuse Chapter Hears Patent Counsel

C. M. Hutchins, patent counsel,
General Electric Co., addressed 96
members of the Syracuse chapter at
their annual spring dinner meeting
held at the Hotel Deauville, Auburn,
N. Y. The topic "Presenting Patents
Pending" proved to be both entertain-
ing and interesting and covered a
number of unusual patents.

—Paul H. Hansel

members on the MOVE

Akron chapter member **A. F. Sprankle**, metallurgical engineer from The Timken Roller Bearing Co., has received the 1955 Regional Technical Meeting award from the American Iron and Steel Institute for his paper on "The Effect of Deoxidation Practice and Hot Work Reduction on the Occurrence of Magnaflox Applications in E4340 Steel."

Hartley W. Barclay of Greater New York chapter has been appointed publisher of *Tide*, magazine for advertising executives.

Two Muskegon charter members have been promoted by Shaw-Box Crane, a division of Manning, Maxwell & Moore, Inc. **David Burns** has been named master mechanic, and **Jim Chvala** is now methods engineer.

Another Muskegon charter member, **Leslie Nelson**, formerly with Shaw-Box Crane, is now master mechanic at Mechanics Universal in Rockford, Ill.

Hollis H. Mosher of Detroit chapter has been named Ohio sales representative for the Tool and Machine Div. of Illinois Tool Works.

Carl Halpin, also of Detroit, has been appointed manager of engineering at Ross Operating Valve Co.

William L. Martin of Boston chapter has been named sales manager of the Potter & Johnston Co.

General Electric Co. has announced that **Robert T. Fenwick** has joined the wage rate and labor relations office of its capacitor department.

Ralph J. Mancuso, Jr. of Greater New York chapter, a tooling and production specialist, has been appointed chief administrative engineer of the Aircraft Div. of Ledkote Products Co. of New York, Inc.

H. L. Tigges, past president of ASTE, has been appointed consulting sales engineer for Buhr Machine Tool Co., Ann Arbor, Mich.

Louis D. Martin of Rochester chapter has retired as gear engineer for the Eastman Kodak Co. to open his own gear consulting business in Rochester.

Bernard C. Dunn of Los Angeles chapter has been appointed sales engineer of milling machines, of the Axelson Div. of U. S. Industries, Inc.

The Los Angeles sales branch of Crucible Steel Co. of America has appointed **Robert M. Simpson** of Santa Clara Valley as manager.

Everett O. Clark, member of Detroit chapter, has been named manager of Vickers Inc. midwest branch.

Roy A. Radtke, charter member of Milwaukee chapter, has been elected president of the Industrial Arts Association.

Several Chicago chapter members have recently received appointments in the manufacturing engineering section of Bell & Howell: **Edward J. Artwick**, chief manufacturing engineer; **Daniel J. Yomine**, manager of production engineering; **Clarence B. Stahlberg**, chief process engineer; and **Adrian Cammelot**, assistant to the chief manufacturing engineer.

J. J. Pippenger of Ann Arbor Area chapter has been elected president of the National Fluid Power Association for the coming year.

E. A. Heidlinger of Detroit chapter retired as district manager of the Detroit office of the Leland-Gifford Co.

Promotion of two Hartford chapter members has been announced by Pratt & Whitney Co., Inc. **Edward N. Clark**, formerly superintendent of cutting tool manufacturing, is now assistant factory manager of the cutting tool and gage divisions. **Ralph Winspear** has been promoted from assistant to superintendent of the cutting tool division.

Leonard A. Rafferty of Pittsburgh chapter is now manager of the Pittsburgh office of Motch & Merryweather Machinery Co.

Semon E. Knudsen of Detroit chapter has been named general manager of Pontiac Div. of General Motors Corp.

Band Machining Discussed At San Gabriel Valley

On June 7, San Gabriel Valley chapter met at the Rainbow Angling Club to hear a talk on band machining by R. H. Franzen, president of the DoAll Western Co. Mr. Franzen's talk was supplemented by two sound films which illustrated the use of modern band saws with automated feeds.

This process reveals the unlimited possibilities for removing metal at extremely rapid rates in the production of practically any conceivable shape in material.

—John H. Stacey

Muncie Has Plant Tour For June Meeting

Eighty-five members of Muncie chapter were guests of Mason Hamilton, manager of the Dana Corp., Marion, Ind. for their June 3 meeting.

After dinner in the Dana cafeteria Mr. Hamilton gave a short talk and then conducted the members through the plant.

—Arthur E. Kurtz

Majestic Company Host To Fort Wayne Group

After a brief review of corporate history by the president, Kenneth Triggs, the Fort Wayne chapter was conducted on plant tour of the Majestic Co., Inc., manufacturers of heating and air conditioning units and builders' supplies.

At the chapter's regular meeting, coffee speaker John B. Thimlar of Hudson Tool Service, Inc., discussed presidential campaigns from the time of Washington to 1840.

—Russ Snyder



SPRINGFIELD, MASS.—Shown is a group at the Springfield chapter meeting, where A. W. Swift, engineer, with Handy and Harmon Co., spoke on "Automation in Silver Alloy Brazing." At their June meeting, John C. Koskey, public relations director for Wales-Strippit Corp., spoke on the application of his company's stripping units in the punch and die field.

—Allen M. Johnson

Positions Available

AUTOMATION EXPERT TOOL ENGINEER—Extensive experience in selecting and feeding mechanisms. As applied to broaching, slotting, drilling, tapping, grindings, thread rolling and punch press operations, such as blanking and piercing, etc. Related to mass production of screw machine products—leading fastener manufacturing plant in Southern California. Excellent working conditions—live in one of America's foremost playgrounds. Send resume; state salary expected and availability to Box 084, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

PROJECT ENGINEER—Excellent opportunity for M.E. experienced in planning and estimating cost of parts and tooling. Familiarity with design and operation of progressive dies. San Francisco manufacturer, steady employment, progressive and expanding company, international distribution, modern plant and equipment. Excellent Company benefits. Please state age, education and minimum salary requirements in first letter. Include detailed resume of experience. Schlage Lock Co., P. O. Box 3324, San Francisco, Calif.

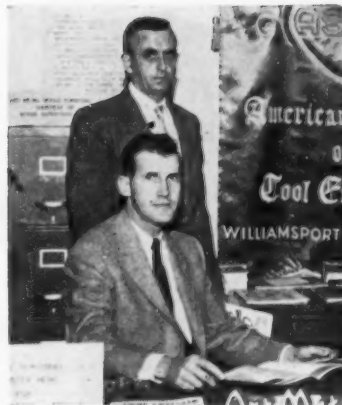
TOOL DESIGNERS—One experienced in designing progressive dies for high volume production. One experienced in designing jigs, fixtures, gages, rotary indexing fixtures and automated assembly fixtures for high volume production. San Francisco manufacturer, steady employment, progressive and expanding company, international distribution, modern plant and equipment. Excellent Company benefits. Please state age, education and minimum salary requirements in first letter. Include detailed resume of experience. Schlage Lock Co., P.O. Box 3324, San Francisco, Calif.

CARBIDE TOOL SUPERVISOR—Nationally known New England tool manufacturer. Must be skilled in brazing and grinding of carbide tip tools. Permanent position. Please send resume covering experience, salary expected and availability. Box 082, The Tool Engineer, 10700 Puritan, Detroit 38, Mich.

TOOL SALES ENGINEER—to manage and direct sales and application engineering work on ceramic cutting tools. Mechanical engineering background with two to five years' experience in the application of carbide tooling required. Write to Box 083, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

STUPALOX—sintered oxide tools, gages and wear parts . . . requires field sales engineers at various territories throughout U. S., tool engineers at Latrobe, Pa., manufacturing engineers specializing in grinding at Latrobe, Pa. and tool sales correspondents at Latrobe, Pa. Contact Carborundum district managers in Cleveland, Chicago, Springfield, Mass., St. Louis, Mo., Atlanta, Ga., Detroit, Los Angeles or Latrobe, Pa. (Stupakoff Div. of The Carborundum Co., Latrobe, Pa.)

MANUFACTURERS REPRESENTATIVE—Rapidly expanding Detroit cutting tool manufacturer specializing in special tungsten carbide and high-speed precision boring tools, single-point turning tools, end form tools, and milling cutter blades desires representation in New Jersey, Maryland, California and in Philadelphia, Pa. and Des Moines, Iowa. For further information send complete details of background to Box 081, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.



WILLIAMSPORT—Dale Chubb, chapter chairman, and George E. Lunt, past chairman, are shown at the chapter booth in the Sesquicentennial Industrial Exhibit held at Williamsport.

—Forrest Johnston



CENTRAL PENNSYLVANIA—Chapter chairman E. T. Wenrich upon awarding a junior membership in ASTE, presents the *Tool Engineers Handbook* to Robert A. McNamara, outstanding vocational high school graduate in the field of engineering.

—Paul Leese



CINCINNATI—Attending Cincinnati's annual dinner meeting are (front row, seated): J. H. Elfring, Jr., past chairman; W. K. Bailey, president, Warner & Swasey Co.; Dr. Max Kronenberg, chairman; President H. C. McMillen; back row: B. H. Rusk, secretary; M. A. Duff, Jr., first vice chairman; Julius Steinhoff, second vice chairman; and Frank Houston, treasurer.

—M. A. Duff, Jr.

Positions Wanted

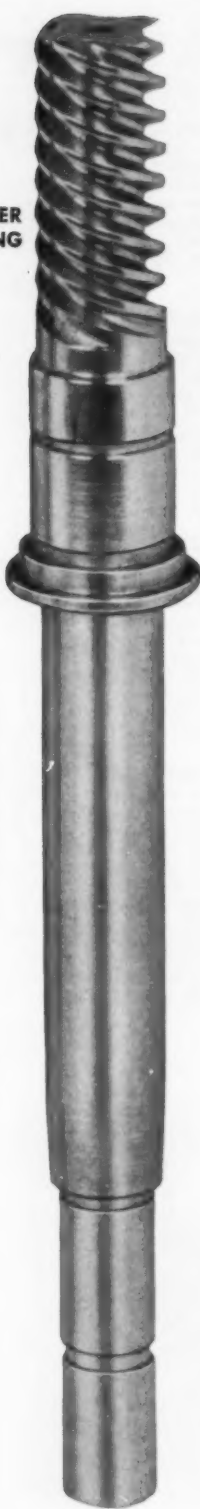
INDUSTRIAL SALES—College background, experienced in calling on tool and die industry. Age 28 and married. Prefer Central New York territory. For resume, reply to Box 085, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURING ENGINEER—with an undergraduate education in mechanical engineering and a postgraduate education in business administration; diversified industrial experience in supervising inspection of navy shipbuilding contracts, tool design, production planning, and product design and development seeks position with progressive and expanding organization. Write to Box 080, News Department, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

BEFORE
BRUSHING



AFTER
BRUSHING



7 finished for the price of 1

COMPLEX business machines have as many as 25,000 moving parts. Although most of these parts must meet exceptionally high quality standards, production economy is also an imperative consideration.

Take the armature shaft shown on the left, as typical. Osborn Brushmatic® methods improve the finish of the worm gear from an original 30 down to 4 micro-inches, at $\frac{1}{2}$ the cost of the former method. *Seven parts finished for the price of one.*

An Osborn Brushing Analysis, made at no obligation to you, will point out how you can use Brushmatic finishing to achieve similar results and savings. Write The Osborn Manufacturing Company, Dept. K-26, 5401 Hamilton Avenue, Cleveland 14, Ohio.



Major manufacturer of business machines uses six different Osborn Brushmatic® 3-A machines to finish parts in lot quantities of 300 to several thousand.



BRUSHING METHODS • POWER, PAINT AND MAINTENANCE BRUSHES
BRUSHING MACHINES • FOUNDRY MOLDING MACHINES

Osborn Brushes® 

PROGRESS IN PRODUCTION

PRECISE THICKNESS ACROSS METAL WIDTH PROVIDED BY MAMMOTH ROLLING MILL

Considered the first such unit designed specially to use a water-emulsifiable mineral oil as coolant lubricant for the rolls, this 16-in. Sendzimir cold rolling mill has been placed in production at the Forestville, Conn., plant of Associated Spring Corp.'s Wallace Barnes Steel Div. The new mill is capable of rolling strip steel up to 13 in. wide and will increase by up to 50 percent the facility's steel-rolling capacity.

Of particular importance to the plant engineers is the mill's ability, through automatic controls, to provide greater uniformity of thickness across the width of the strip as well as along its length. The mill also is constructed to make it possible to roll unusually thin gages of steel.

The mill was designed by the Armzen Co. and built by Waterbury Farrel

Foundry & Machine Co.

It is because of the coolant used, which has about four times the heat transfer rate of plain mineral oil used in other Sendzimir mill, that a greater reduction in the thickness of the strip can be made at each pass through the mill without annealing between passes. By decreasing the number of passes, time required to bring steel down to the final desired gage is shortened. Extra cooling capacity also allows the strip to be passed through the rolls at speeds up to a maximum of 1000 fpm.

Multiple-roll design of the Sendzimir mill prevents deflection or bending of the roll across the width of the strip. The strip as rolled is almost perfectly uniform in thickness all across its width rather than having a heavy center tapering to thinner edges.

CASTING GROUP SETS UP NEW METAL SPECIFICATIONS

Data gained from several years' research and study by the Investment Casting Institute has been used to formulate specifications metal compatible to both user and producer requirements. The standards, designed to aid design engineers and other persons specifying investment cast parts, are identified by a code number in line with the new code number system developed under the Standardization Plan of the Secretary of Defense.

According to Roger F. Waindle, a past president of ASTE and chairman of the Institute committee, "one of the problems often encountered is that investment castings may be redesigned from stampings, forgings or machined parts, and in the absence of specific investment casting specifications, are sometimes specified to wrought metal specifications by the purchaser.

"Since metal specifications contain control data peculiar to a particular method of fabrication, it is unwise to expect wrought specifications to always be satisfactory for investment castings."

First of the specifications include:

FE-1 A general iron-base specification on carbon steels based on the SAE 1020 and 1040 steels.

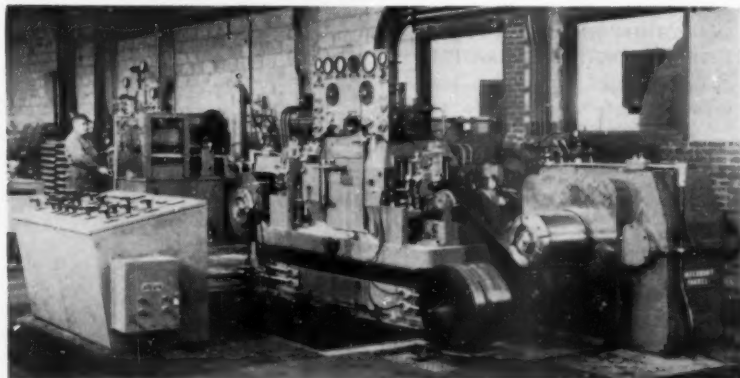
FE-2 This code covers the low alloy steels, commonly referred to as SAE alloy steels and are casting conversions of 4130, 4140 and 8730 SAE types.

CO-1 and NI-1 These specifications are cobalt base and nickel base super alloys respectively and are based upon the familiar aeronautical material specifications covering this type of alloy.

MG-1 This is a specification for magnesium base, aluminum-zinc alloy.

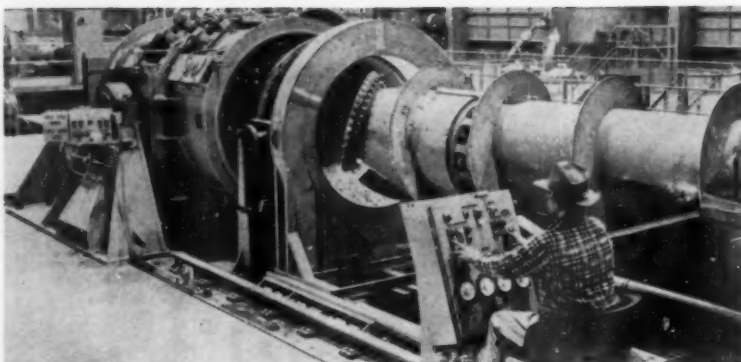
AL-1 This covers the two most popular aluminum casting alloys, silicon-magnesium and silicon-copper.

CU-1 This specification is designed to cover silicon-brass.



PRODUCE TITANIUM METAL BY NEW COMMERCIAL PROCESS

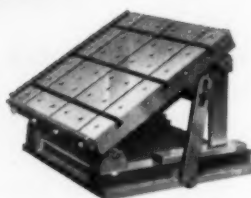
A method other than the magnesium-reduction process is being used in the United States to produce titanium sponge with the entry into this field of the new Ashtabula plant of Electro Metallurgical Co., Div. of Union Carbide and Carbon Corp. The new Electromet plant, which has a capacity of about 7,500 tons of titanium metal sponge a year, uses a sodium-reduction process. In this technique, sodium is used to reduce titanium tetrachloride, resulting in high quality metal.



Operator removes titanium product from the reactor at the Ashtabula plant.

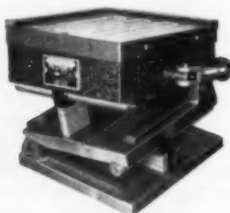
Robbins ...THE COMPLETE LINE OF ANGULAR TOOLING EQUIPMENT

Save dollars in valuable tool room time on every job! Set-ups that require hours by other methods take minutes the Robbins way. Just four simple steps: (1) Look up required angle in Table of Constants furnished with each tool, (2) Select gage blocks from the Table, (3) Place gage blocks between base of unit and sine bar swivel block, (4) Secure the work . . . and you're ready to go! Complete range of models and sizes brings Robbins precision equipment within the reach of every shop, large or small.



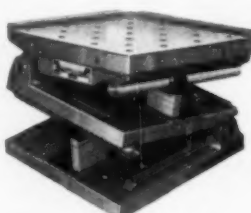
HEAVY DUTY SINE PLATES FOR MILLING AND BORING

Fool proof! Rugged enough to take thrust and chatter of heavy cuts . . . yet built to tool room accuracy for the most exacting inspection operations.



"MAGNA-SINE" MAGNETIC TABLES FOR PRECISION GRINDING

Set up and grind any single or compound angle fast! Work is held securely by magnetic attraction, clamped or released in an instant. Work can't warp or move.



INSPECTION SINE PLATE FOR EVERY INSPECTION OPERATION

Eliminate chance of errors in inspection department and tool room! No more V-blocks, angle plates, or complicated built-up sets of blocks. Simple, fast and sure.

Write or call for complete information now!

OMER E. Robbins COMPANY
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Also producers of special machinery, gages and fixtures
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-140

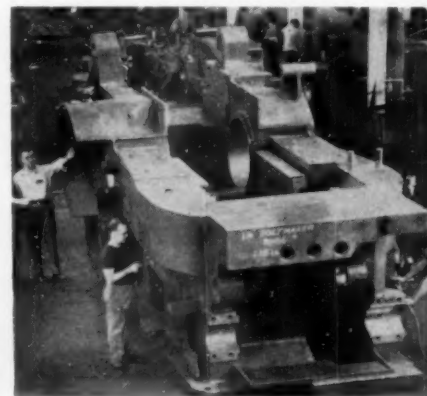
The company has had this process, which offers economic and technological features and advantages, in operation on a pilot and prototype plant scale at its Metals Research and Development Laboratories in Niagara Falls, N. Y. More than six years' time and over \$2-million worth of research and development have preceded start of the commercial venture.

The titanium sponge produced is remelted into ingots by producers of titanium mill products and commercial shapes.

196-TON BOLTMAKER NEARS COMPLETION

Largest boltmaker in the world, standing twice as high as a man, will cold forge raw stock of 1 7/16-in. hot-rolled steel rod down to size and produce giant cap screws 1 1/4 in. in diameter, 10 in. long at rates up to 40 per minute. The screws produced by this giant unit will weigh about five pounds each.

The unit, biggest cold forging machine ever designed, is being built for The Cleveland Cap Screw Co. by National Machinery Co. Delivery is expected before the end of 1956; it will be



The Tool Engineer

housed in Cleveland Cap's \$4,500,000 plant now nearing completion.

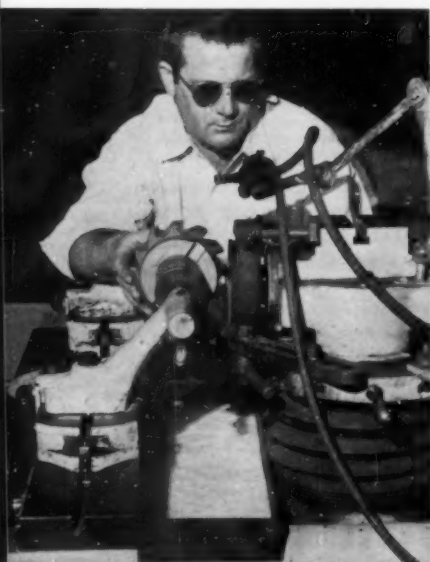
In operation, the machine will be tended by three men at three control positions: one at the wire-drawing end, where 2800-lb coils of 1 7/16-in. steel rod will be fed, a second at the conventional mid-machine post, and a third at the thread rolling end. Drawing the steel rod to size, the machine cuts off the stock in proper lengths, extrudes the blank, heads, trims the head, points the end and rolls the threads on, all automatically. When at work, the giant unit will consume a ton of steel every 10 minutes.

ECONOMY THROUGH SIMPLE SALVAGE PLAN

Small, shallow pans placed under diamond grinding wheels are salvaging more than \$1200 of industrial diamond chips a month for Douglas Aircraft Co. This simple salvage system was introduced at the Torrance facility of the company's El Segundo Div. where diamond grinding wheels are used to sharpen carbide tools. Tiny diamond chips that make up the wheels are torn loose from their resin binder and ordinarily are lost.

During grinding, a mist coolant aids in directing chips to the pans where a sludge builds up. Pans are emptied through a flannel strainer that permits fluids to drain off; the retained sludge is thoroughly dried in an oven. This residue is shipped to the diamond wheel manufacturers who have means of reclaiming the diamonds.

During the first 30-day period of the experiment, the system salvaged 738 carats of industrial diamonds.



August 1956



Vulcan's Gage & Die Steel

Now... save time and money on smaller tools and dies with Vulcan's new VULground gage and die steels—by eliminating initial tool steel finishing costs. This precision-ground, excellently finished flat stock comes ready for application.

VULground is now available in oil hardening and air hardening tool steels—in flats and squares, standard 18 inch and 36 inch lengths, in a wide variety of thicknesses and widths.

Vulcan's reputation for highest quality goes with every shipment of VULground gage and die steel. Depend on it *regularly*. Send now for descriptive folder and prices.



Vulcan Crucible Steel Division

H. K. Porter Company, Inc.

Aliquippa, Pennsylvania

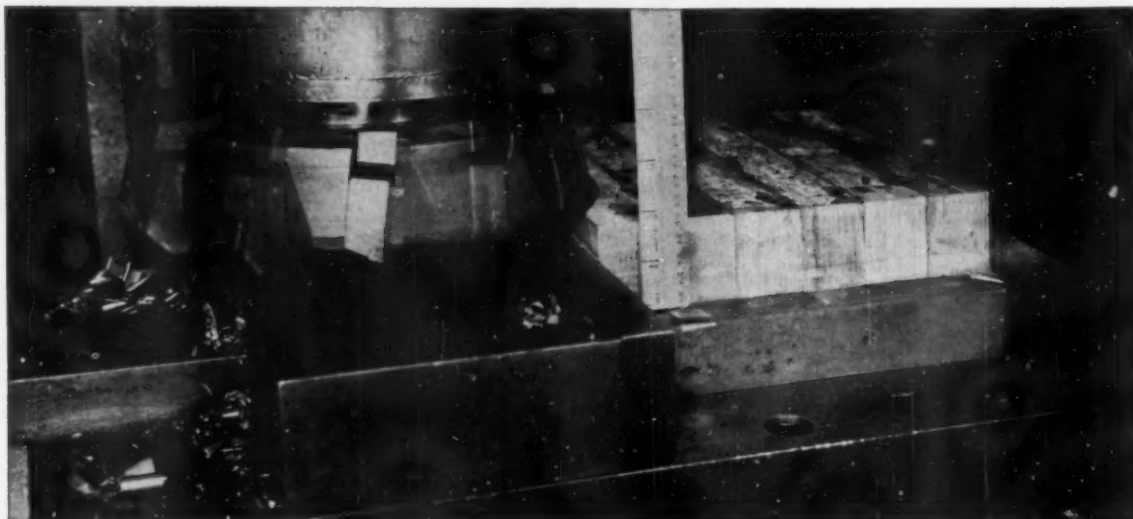
Offices and warehouses in principal cities

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CARMET[®]

STEEL-CUTTING CARBIDES

① INCREASE PRODUCTION ② GIVE UP TO 50% LONGER LIFE



DETAILS OF JOB ILLUSTRATED

Machine.....Sundstrand Rigid Mill
Cutter Size.....10" Diameter
No. of Teeth.....12
Carbide Inserts (grade)....Carmet CA-610
Rate of Travel.....400 S.F.P.M.
Table Speed.....10 in. per minute
Depth of Cut.....1/2 inch
Material.....1095 Cold Drawn Shank
Steel, 200 Brinell

**READY
FOR YOU**

Complete Technical and
Shop Data on the Carmet
"CA-600 Series" of special
steel-cutting Carbides

Write for Your Copy

ADDRESS DEPT. TE-80

Here's something *special* for you: the new Carmet steel-cutting grades of carbide, called the "CA-600 Series." One of the grades is shown above in a milling operation—a tough job where the major requirement was continuous production. Cutters equipped with Carmet CA-610 inserts not only increased the production of the machine on this job, but actually gave 50% longer life than the comparable cutting materials previously used.

These heavy-duty CA-600 Carmet grades (premium products in performance, *at no premium in price*) have been thoroughly job-proved in the field. They're available to fit *your* steel-cutting requirements . . . let us arrange a demonstration of their ability to save time and money for you. Get in touch with your nearest A-L representative or distributor, or address *Allegheny Ludlum Steel Corporation, Carmet Division, Detroit 20, Michigan.*

For ALL your CARBIDE needs, call
Allegheny Ludlum[®]



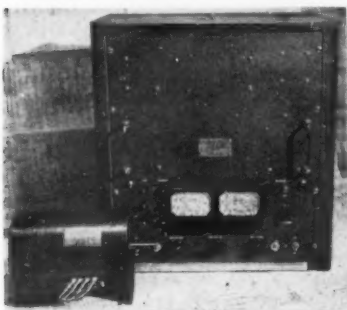
TOOLS

of today

Automatic Control System

Basic control device for industrial control applications consists of a new motor incorporated in an automatic control system which permits a multiple series of operations to be programmed on tape or punched cards for the automatic operation of milling machines, lathes, grinders, drills and other machine tools.

The special step motor, developed by the Industrial Controls Corp., provides



precision and rapid operation applicable to instrumentation uses.

The new system is simple and the motor, together with its special amplifier, requires only 20 vacuum tubes as compared to 400 for earlier systems.

This unit combines ability to control displacement precisely and to provide the necessary power. The system also provides a simple means for eliminating hunting.

As the system operates, a tape or punched card is the control medium, with one mark or other characterization on the tape corresponding to one step motion of the motor, thus providing an

electrical gear system. Individual steps can be made so fine and the motor operated at such a high speed that the work output of the motor is smooth.

Because several motors can be controlled by a single tape, three or more units can be tandemed for the multiple operations required by machine tools.

Other characteristics of the unit are its high starting torque, accuracy in indexing and the magnetic locking of the motor when it is stopped. Ultrafast acceleration and deceleration provide a high degree of sensitivity.

Reliability of these units makes it generally unnecessary to incorporate feedback.

The Teller Co., Butler, Pa. T-8-1431

Bonding Material

Bondized Califilm (fluorothene, Kel-F) and Kelon-F (Kel-F) sheets are specially treated on one or both sides to allow bonding to a variety of materials or to themselves using commercially available adhesives.

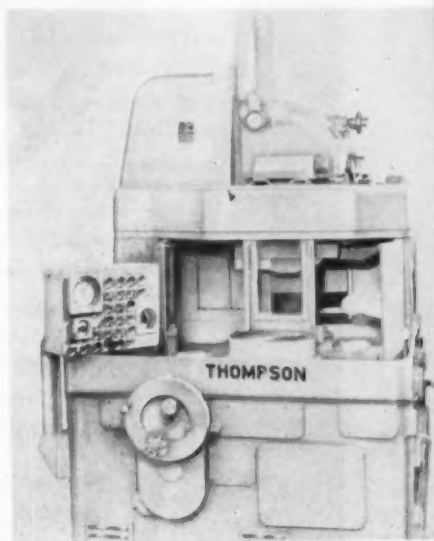
These materials can be cemented to steel, aluminum, wood, plastics, cardboard or rubber. Califilm is available in thicknesses ranging from 0.005 to 0.015 in., in widths up to 16 in. Califilm can protect surfaces from wear and corrosion. Kelon-F sheets are available in thicknesses ranging from 0.015 to 0.250 in. When applied to metals, plastics or woods, Kelon-F provides low friction, and high corrosion and wear resistance along with self-lubrication. It also has good chemical, electrical and thermal properties, and is chemically inert and nonadhesive.

Shamban Engineering Co., 11617 W. Jefferson Blvd., Culver City, Calif.

T-8-1432

Twin Production Grinders

This line of Type TR twin rotary circular grinders is designed to permit the operator to load one magnetic chuck at front position while another part is being ground automatically in rear position. Machine cycle is automatic. The line is available in six sizes of worktable.



ranging from 6 to 24 in. in diameter. Maximum diameter swing work clearance ranges from $6\frac{1}{2}$ to $25\frac{1}{4}$ in. Table speed ranges from 29 to 230 rpm for the 6-in. unit, to 6.6 to 66 rpm for the 24-in. unit.

Features include horizontal wheelhead grinding with 14 or 20-in. diameter wheel to controlled size with automatic compensation of the feed screw; free

loading time enabling operator to arrange other parts or operate machines; in-position wheel truing to dress wheel automatically; pre-set and to machine cycle, and assured accuracy of finish with automatic wheel truing and spark out.

The Thompson Grinder Co., Springfield, Ohio.
T-8-1441

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Ring and Circle Shear

No. 31-RC ring and circle shear is designed with a self-compensating circle arm which floats on guided ways to maintain true center automatically.

With a scale provided for convenient setup, an adjustable crank permits quick positioning of the circle arm for cutting circles of various diameters. Quick-acting cam lever actuates the center clamp of the circle arm which is adjustable to hold varying thicknesses of material securely.



Straight line work and irregular outlines, as well as circles, circular holes and rings may be cut with this shear. With a capacity of 10 ga mild steel, it cuts circles from 6 through 78 in. in diameter.

A hand wheel controls raising and lowering of the cutter, permitting the cutting operation to be started at any point on the blank.

High-carbon high-chrome steel cutters assure clean, fast cuts. Both an adjustable swinging gage for centering unmarked blanks and an adjustable straight slitting gage are furnished as standard equipment.

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.

T-8-1442

WALKER

and a great industry



For more than fifty years automotive production has relied on Walker holding devices. One of the most popular chucks in the Detroit area is Walker 617 CG (concentric gap) type, a rectangular chuck that combines longitudinal and transverse gaps. Produced in sizes to meet all holding requirements.

Walker engineers can solve any holding problem.

What is yours?

O. S. WALKER CO. Inc.

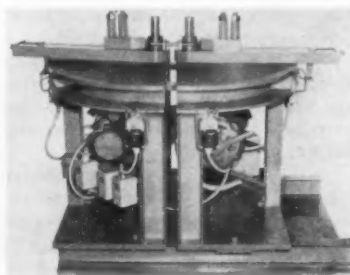
WORCESTER 6, MASSACHUSETTS

Original Designers and Builders of Magnetic Chucks

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-144

Bending Machine

Both ends of a pipe, tube strip or shape may be bent simultaneously on this unit which comprises two machines each with a motor and relay control. The machines, controlled from a single starting button, are mounted on a base, and distance between them can be adjusted. Normally, one unit bends clockwise and the other counter-clockwise, although both units may be made to bend the same direction. Also, the units may be made to bend to different degrees of curvature up to 180 deg. Unit positions are adjustable either manually or by means of a lead-screw driven by a motor, and the machine may or may



The Tool Engineer

not be provided with an ejector.

A simple machine, when fully equipped it can be made fully automatic, taking stock from a hopper and delivering it to a conveyor in finished condition. Its primary use is in bending two right angles in the same plane simultaneously. It can also be used to bend closed curves such as rectangles or polygons.

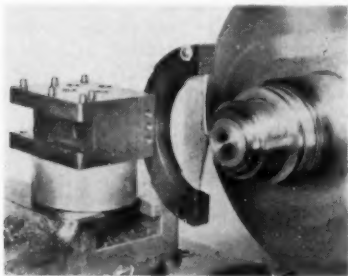
Pedrick Tool and Machine Co., 3642 N. Lawrence St., Philadelphia 40, Pa.
T-8-1451

Cut-Off Assembly

Economy in cutting time, blade replacement costs and power are possible with this Speedway cut-off tool assembly for lathes and automatic machines.

It is designed without an overhang and the cutting edge is supported by tension instead of in bending. This construction permits the use of a thin blade in relation to the depth of the cut.

Because the blade is hung vertically



there is no tool chatter. Less heat is created than with conventional type blades, assuring long life.

The low-cost tool is stable on interrupted cuts such as hex, octagon and square materials, and is well suited for work on blanks of all kinds. Blades and holders are available for cuts up to 4½ in. The complete assembly is easily adaptable to automatic, turret and engine lathes.

Wye-Stanley Tool Co., 3503 East Olympic Blvd., Los Angeles 23, Calif.
T-8-1452

Punching Unit

Round and shaped punches can be used interchangeably in the CJ punching unit, which has a diameter capacity of 1¼ in. in ¼-in. thick mild steel or equivalent material. High-strength alloy castings assure strength and long wear.

Guide and die keyways are machined simultaneously to assure positive alignment of punch and die. Two keyways in the punch and die allow 90-deg positioning of each shape. Other angles of key-

SPECIFY ADAMAS PREMIUM GRADE 548

for all finishing and semi-roughing on tough alloy steels, with or without interrupted cuts

- MORE WEAR RESISTANT • MORE SHOCK RESISTANT
- GREATER STRENGTH • RESISTS CRATERING

Formulated specifically for finishing and semi-roughing operations on high alloy steels, ADAMAS PREMIUM GRADE 548 is the hardest carbide grade used successfully on interrupted finishing cuts.*

When encountering cratering in machining the 300-series stainless steels with straight tungsten carbide grades, change to ADAMAS PREMIUM GRADE 548. You will get far more crater resistance without sacrificing edge wear resistance.

Particularly suitable for application on automatic machines, ADAMAS PREMIUM GRADE 548 is excellent where some shock and excessive edge wear are encountered on light cuts.

**For continuous cuts on low carbon steels, use ADAMAS standard grades C and D.*

**SPECIFY ADAMAS PREMIUM GRADE 548 FOR...
MORE CHIPS AT LOWEST COST!**

ADAMAS

ADAMAS CARBIDE CORPORATION, KENILWORTH, NEW JERSEY

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-145



with a **TINIUS OLSEN AIR-O-BRINELL***

The large gauge on this air operated Brinell Hardness Tester shows exactly how much load will be applied **BEFORE** the test is made. Any Brinell load from 500 kg to 3000 kg is obtained, quickly and accurately. Operator variables are eliminated. Reproducible load application is assured.

In every respect, the Tinius Olsen Air-O-Brinell is the modern answer to more efficient metal hardness testing. Here is the one tester that combines laboratory accuracy with shop ruggedness. Furthermore, this semi-portable tester can be used anywhere that standard air pressure is available—in the lab or right on the production line.

It will pay you to get the facts about the Olsen Air-O-Brinell. Write today for Bulletin 52.

There's an Olsen for Every Physical Testing Need.

*Patents Applied for

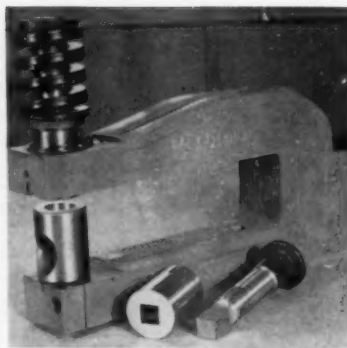


Trademark
Reg. U.S. Pat. Off.

TINIUS OLSEN
TESTING MACHINE COMPANY
2110 EASTON RD. WILLOW GROVE, PA.

Testing and Balancing Machines

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-146



ing are also available.

The unit is designed to permit quick die change without removal of the unit from the press setup and also to allow quick rotation of the die for controlled slug ejection.

Wales-Strippit Corp., 345 Payne Ave., North Tonawanda, N. Y. **T-8-1461**

Fractional Adding Wheel

Continuous adding or subtracting of fractions may be done on this fraction-of-an-inch adding machine. Designed in disk form, it also includes decimal equivalents so mixed fractions and deci-



imals can be added or subtracted. It is so constructed that answers are shown immediately.

Fast and simple to operate, there is only one moving part.

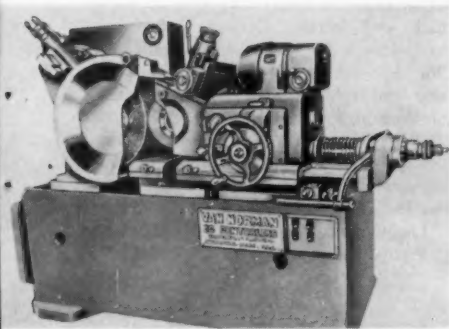
Sheridan Advertising Specialties, 26032 Grand River, Detroit 19, Mich.

T-8-1462

Centerless Grinder

Heavy-duty No. 2C centerless grinder is designed for speed, accuracy and economy of operation. Actually, it does the work of three machines without change-over time. It is a standard centerless grinder for through-feed work, a standard grinder for infeed jobs and,

The Tool Engineer



equipped with the crush dressing attachment, it form grinds and does profile work. It finish grinds solid or rough-turned parts made of metal, plastics, glass, etc.

Grinding wheel spindle is totally enclosed unit type construction. It requires no warm-up period. The 1½-hp regulating wheel drive motor is infinitely adjustable. There is an independent hydraulic wheel-truing device for each wheel; fine handwheel adjustment on diameter of workpiece; one-shot lubrication.

The grinder has a work capacity to 4¾-in. diam. Grinding wheels available include 24 x 4 x 12 in., 24 x 6 x 12 in., 24 x 8 x 12 in., while regulating wheels are 12 x 4 x 5 in., 12 x 6 x 5 in., and 12 x 8 x 5 in.

Wheel speeds have a low range of 10 to 57 rpm and a high range of 60 to 355 rpm.

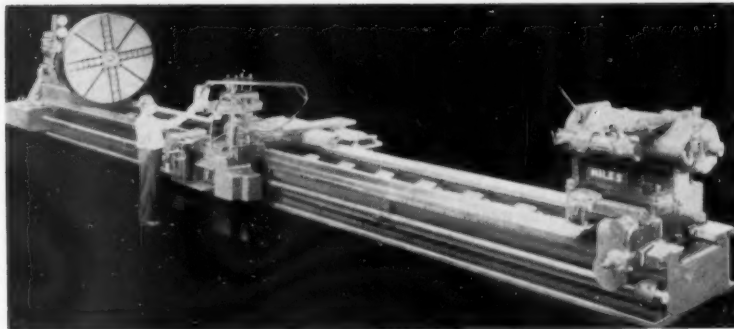
Van Norman Machine Co., Springfield 7, Mass. **T-8-1471**

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Engine Lathe

Heavy duty Model 72-A Niles engine lathe incorporates speed and load indicators on the faceplate drive; load indicator on the adjustable, spring-loaded tailstock quill; fully enclosed leadscrew speed and thread selector dial; hydraulic booster on the faceplate speed changer; lubrication oil-pressure protection; optional electronic feed control.

Whether feed is controlled electronically or mechanically, the operator has complete control at the carriage station through a pushbutton panel. The electronic feed-box, mounted at the machine's tailstock end, drives the splined leadscrew. Rate of longitudinal, cross, or angular feed, in inches per revolution of the faceplate, remains proportionate to any change in faceplate speed. Safety interlocks prevent simultaneous engagement of electronic and mechanical feeds. When electronic feeds and threading are incorporated in the lathe, mechanical



feeds also are available. One lever selects either mechanical or electronic feeds; 65 feeds are available.

Main drive for the lathe is a 100-hp, adjustable-speed, 400 to 1600-rpm, d-c motor, but variable-voltage drive can be substituted. Jog buttons for forward and reverse are mounted on the headstock to facilitate gear shifting.

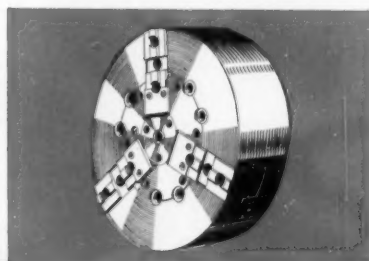
The faceplate, with adjustable-speed direct-current drive, has three mechanical speed ranges; through faceplate drive, 1.35 to 5.4 and 5.48 to 21.9 rpm; through spindle drive, 25.2 to 101 rpm.

Powered traverse motions, independent of main feeds and spindle, are obtained with a separate 5-hp motor mounted on the carriage apron and operating through a safety friction clutch.

Swing over bed and carriage bridge is 73½ in., and over carriage bridge is 56 in. Faceplate diameter is 72 in. Distance between centers is nominally 46 ft., but can be made to suit customer specifications. Over-all length is 13 ft. plus distance between centers.

Baldwin-Lima-Hamilton Corp., Hamilton, Ohio. **T-8-1472**

SKINNER POWER CHUCKS



...precision
and power for
high production

They're accurate, safe, dependable and fast! Skinner makes them from 6" to 24" with forged steel bodies, and with 2 and/or 3 adjustable, non-adjustable or serrated jaws.

Power chuck also available in 2- and 3-jaw compensating models for holding rough castings and forgings between centers. Skinner carries a full line of standard soft blank top jaws. Double-acting rotating air cylinders are available for all Skinner power chucks.

Write for free catalog on Skinner power and manually operated chucks and accessories, and for free showings of film "Chucks and Their Uses".

THE CREST OF QUALITY

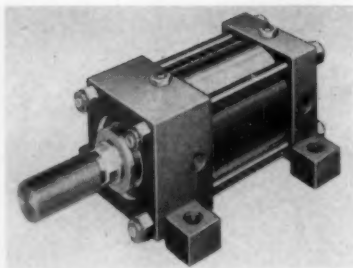


THE **SKINNER**
CHUCK COMPANY
212 Edgewood Ave., New Britain, Conn.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-147

Hydraulic Cylinders

Line of hydraulic cylinders, identified as Super-Matic, provides pressures to 2000 psi, with a maximum stroke of 72 in. They are available in seven bore sizes, ranging from 1½ to 6 in., and in five mounting styles covering foot, trunnion, center line, flange, pivot and manifold types with interchanging covers to permit multiple mounting combinations. The cylinders are made



in standard or heavy-duty sizes in both male and female. Cylinder tubes are hard-drawn and corrosion-resistant for low friction. Ports are unobstructed and can be relocated to any 90-deg position by rotating the cylinder covers. Tie rods are extra heavy to maintain tension and resist shock loads. Cushioning is available for either or both cylinder ends.

Logansport Machine Co., Inc., Logansport, Ind. **T-8-1481**

ARTER

also makes a HIGH one



Vertical capacity of Arter Model B Hydraulic Rotary Surface Grinder can be increased 24" using a raising block. So, for grinding surfaces on such work as the crankshaft housing for the piston-type airplane

engine, as shown, Arter has the answer. Arter has been building rotary surface grinders for nearly forty years. Model B is built in four sizes — 20", 24", 30" and 40" diameters.

Whatever your surface grinding needs, Arter can meet them.

ARTER GRINDING MACHINE COMPANY WORCESTER 5, MASSACHUSETTS

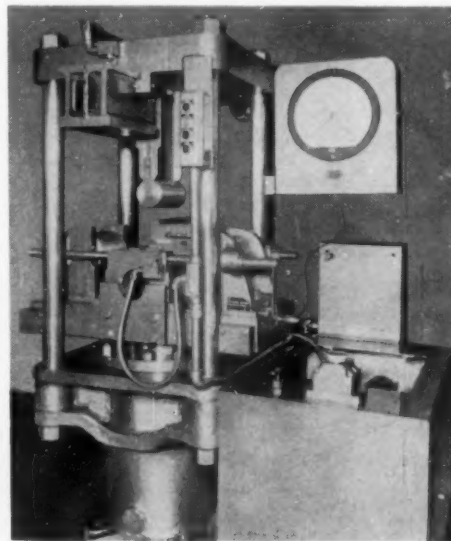
Jigmatic Automatic Tape Controlled Positioning Table • Rotary Surface Grinders
Flat Circular Cutter Grinders • Internal Grinders • Cylindrical Grinders • Carbide Tool Grinders
AGENTS IN INDUSTRIAL CENTERS OF UNITED STATES AND CANADA

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-148

Cold Bending Test Unit

Low-carbon steel bars up to 2 in. square or 2 in. in diameter, in lengths of 5 to 24 in., can be bent in this machine. Tests can be quickly made under loads up to 150,000 lb. The unit also accommodates flats up to 4 in. wide and 1 in. thick in the same lengths.

The bending press is hydraulically operated at controllable table speeds of



1½ to 10 ipm. Maximum upward stroke is 11 in.

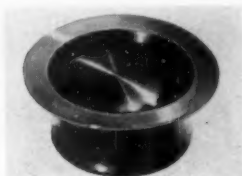
Sliding platens, which can be used quickly after making a V-bend with rollers, bend specimens 180 deg. The sliding platen incorporated in the lower support stand, can be used in the center of the machine without removing the bending pins. Limit switches and pressure relief valve prevent overload. Bending pins for the unit range from 3/32 to 8.46 in. in diameter.

On the underside of the upper fixed crosshead a roller stand and upper platen slide interchangeably into the working position.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. **T-8-1482**

Piston Seal

Class 4 Bellofram piston seal is one of four types of deep convolution, constant area diaphragms designed for use in air and fluid operated instruments, actuators and motors. Deep convolution, flange design permits easy application. It functions efficiently even when associated components are not perfectly



machined or aligned. On instruments and machines having natural parting surfaces between cylinder and mating metal surfaces, the seal functions mainly as a gasket, preventing leakage at this parting surface.

Sizes range from 2.75 to 6 in., in addition to the more than 200 standard and semistandard sizes, available for bore diameters from 1 to 6 in.

Bellofram Corp., Burlington, Mass.
T-8-1491

Brazing Unit

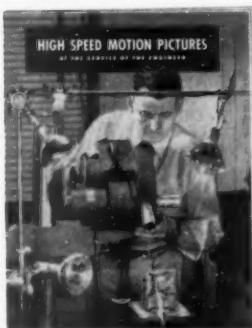
Semiautomatic brazing and soft soldering machine, identified as #20-2 Y-B Multiflame, can also be used for tempering, annealing and hardening. It uses standard flux or preform solder forms. The unit, which can be fitted into any production line, is 60 in. long, 24 in. wide and 34 in. high. It operates on manufactured, natural or LP gas, with conventional shop airlines supplying air pressure. Simple to install, set up and maintain, it requires only semi-skilled operators.

A regulated conveyor belt establishes production speeds. Materials move through a heating zone that can be adjusted to accept materials from 0 to 10 in. wide and from 0 to 30 in. high.



Everyone working on
design and performance
problems of fast mechanical
motion should have a copy
of "High Speed Motion Pictures
at the Service of the Engineer,"
a new booklet obtainable
without charge from . . .

EASTMAN KODAK COMPANY
Rochester 4, N. Y.



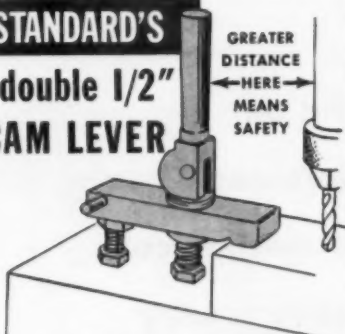
It tells about the new fast films for
high speed movies and how vari-
ous industries are using the Kodak
High Speed Camera.



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-149

* CERTIFIED ...up to 3,450 lbs. clamping force

STANDARD'S double 1/2" CAM LEVER



* THE JAMES H. HERRON CO., (Laboratories for Testing, Analysis and Inspection) reports as follows: "With reference to the Double Cam Lever (500) and Eye-Bolt (500), we have conducted experiments to determine the amount of clamping force a man can exert with this device, lubricated. "Without the use of any auxiliary equipment, it was found that a man could exert up to 3,450 pounds, by bringing the lever to a position 90° with the Eye-Bolt."



**Finger Tip Can
Tighten Clamp.
Easy to Use—
Positive Action**

- Standard's Double Cam Lever offers maximum job clearance.
- Safe Operation—with handle vertical before clamping (as illustrated).
- Constant Maximum Clamping Pressure—perpendicular to center line of lever.
- Certified 6-Ton Back-Pressure Resistance—no danger of cam backing up.
- Ready to Use—no altering needed on assembly.
- No Lever Breakage—solid steel handle.
- This Cam can be applied to your Specially Designed Assemblies. Quotations on request.

OVER 500 OTHER STANDARD JIG AND FIXTURE COMPONENTS

Standard Parts Company offers the most complete line of fine quality tool room standards available today. You can depend on Standard Components—they will never let you down.

•• TWX BEDFORD, O. 462 •••
**WRITE FOR YOUR COPY
FREE CATALOG**
(SIXTH EDITION)
illustrating our complete
line of top quality jig and
fixture parts.



STANDARD PARTS CO.

1012 BROADWAY • BEDFORD, OHIO

INDICATE A-8-150-1

150

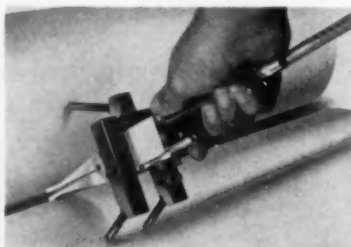
Burner manifolds can be adjusted to allow properly angling flames for the most complex joints. Where highly complex or multiple joints demand, rotating worktables can be added to conveyor belt to revolve work within heating zone.

Youngberg Brothers, Meriden, Conn.
T-8-1501

Air Gage

This air-caliper gage, Model A-149 P-1, provides direct measuring for spacing between calender rolls to determine whether or not rolls have been ground correctly over their entire width.

A portable caliper gage, it contacts the rolls directly and transfers measurement from the caliper type contacts to an air gaging spindle. Variation in space between rolls is shown on a Dimensioner dial. Because there is direct



mechanical contact between the gage and the crowns of the calender rolls, positioning is quick and positive. Locating bars or legs assure gage contact penetration to the proper depth. Scissor type construction permits insertion at the point of minimum spacing between the calender rolls for fast, accurate checking anywhere along the entire width.

Federal Products Corp., 1144 Eddy St., Providence, R. I. T-8-1502

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Controlled Atmosphere Furnace

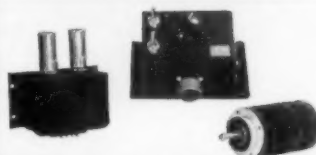
Automatic, controlled atmosphere toolroom furnace, designed for general hardening of tool steels, results in clean surfaces free from decarburization. Operation is simple and inexpensive.

Furnace controls, generator and temperature controls, as well as gas curtain operation are automatic on this GA-4 furnace which is larger than previous models. Chamber dimensions are 10 x 8 in., and the power input 8 kw at 230 volts, single or 3-phase, for operation

Infinitely Adjustable

AC SPEED CONTROL SYSTEMS

FOR INSTRUMENT—



OR INDUSTRIAL—



APPLICATIONS

WacLine Power Systems provide the economical answer to speed control of AC motors under variable or constant-torque applications. Speed is infinitely adjustable over a wide range. Close regulation is readily accomplished even under varying torque. The WacLine system may be applied to single or multi-phase sources on any frequency from 50 to 1000 cycles. Special features such as Program Control, Voltage Signal Response or independent adjustment of forward and reverse speeds are available.

Full Regulation with all the Advantages of AC Motors

- From .1 oz/in. to industrial power requirements.
- Longer Motor life with less maintenance.
- Permits the use of open or hermetically sealed motors.
- Applicable to explosion proof motors.
- Equally effective for large and small power requirements.
- Simple electronic principle, patent-pending.

For further information write:

WacLine, INC.,
35 SOUTH ST. CLAIR STREET,
DAYTON 2, OHIO

Mfrs. of Speed Control Systems—Dummy Loads
Microwave Components—Test Equipment
Photographic Equipment—Medical Equipment.

INDICATE A-8-150-2

The Tool Engineer



to 2000 F.

The atmosphere system consists of a cracking unit to which a mixture of alcohol and water is fed by means of a variable speed pump.

To insure a perfect seal, the furnace is equipped with a welded Inconel retort which prevents heating elements from being exposed to the effect of the atmosphere gases. The gases are confined to the retort chamber.

Cooley Electric Mfg. Corp., Dept. H-3, 35 S. Shelby St., Indianapolis 7, Ind. **T-8-1511**

Gage Blocks

A new category of gage blocks, AAA grade, are made to tolerances of ± 0.000001 in./in. of length by a process that produces a surface finish of 0.09 microinch, rms. They are available in square or rectangular blocks in sets of 86 pieces. Each set is made up of blocks that have been conditioned in the gage laboratory for one year in order to assure stability. Each block has been checked against master gages calibrated by the National Bureau of Standards as well as against light waves by interferometry.

Furnished with each set of gage

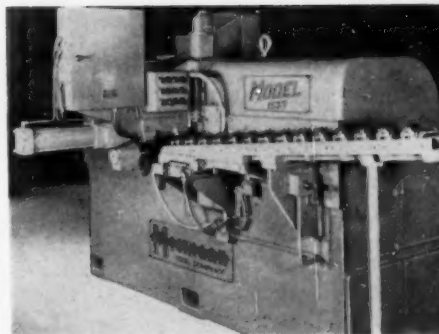


blocks is a certified inspection report giving the exact size of each block to the nearest millionth of an inch. As a result, these gage blocks can be used as master gages for calibrating other gages and making precise measurements.

The DoAll Co., Des Plaines, Ill.
T-8-1512

Spline and Thread Roller

Roto-Flo Model 1537 can roll a spline, or roll a spline plus an adjacent thread, oil groove, etc., in a single pass of the forming racks. Under certain conditions, a third operation such as marking, can be added. Operations can be performed on same or different diameters but the forms to be rolled must be close together along the length of the shaft. Speed is estimated up to 30



times faster than conventional methods, while further time is saved through performance of two operations in a single pass.

By this process, periphery of a metal

COMPARE!

NEW

Eclipse

PRECISION GROUND FROM SOLID

END MILLS

with

Conventional END MILLS




Our END MILLS have an entirely new and advanced flute design with an uninterrupted contour and hook from one flute to the next. Flutes ground from solid hardened blanks with mirror finish allow a smooth flow of chips. Identical flutes as to dimensions and contour give a perfect distribution of cutting load. The form relieved land provides much greater strength to the cutting edge.

RESULTS: longer tool life, finer finishes, and lower production costs.

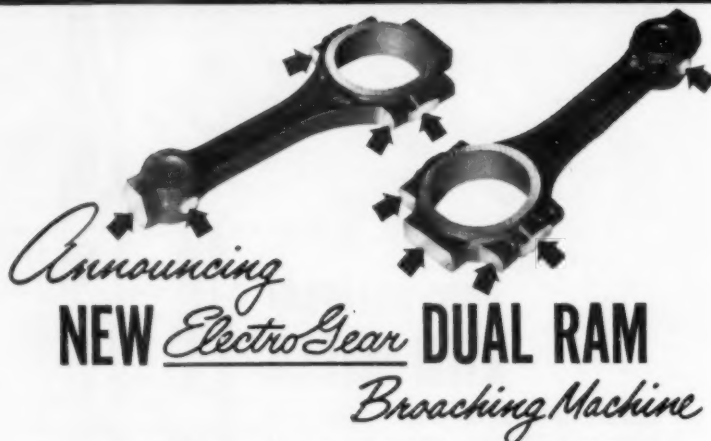
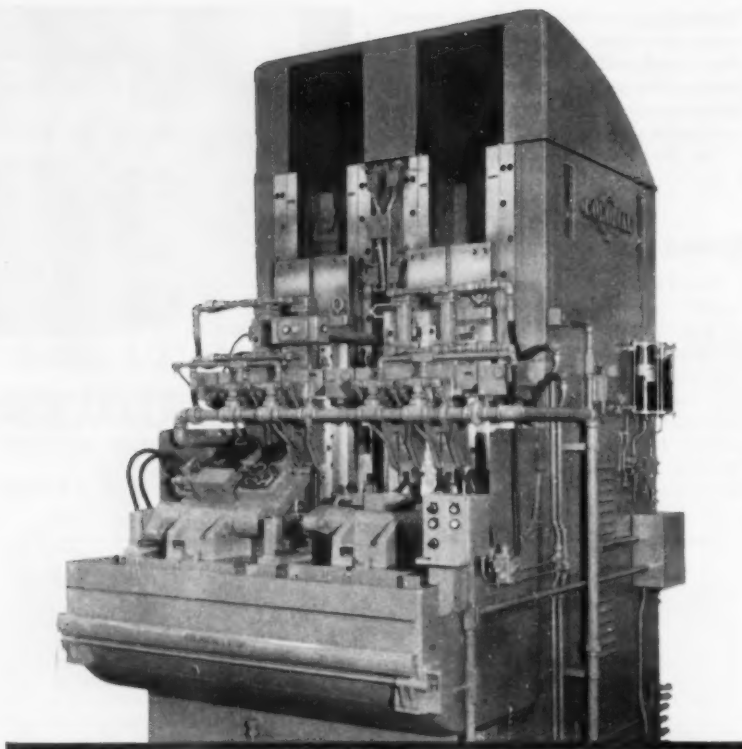
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ECLIPSE COUNTERBORE COMPANY

DETROIT 20, MICHIGAN

END MILL DIVISION—NORTH BRANCH, N. J. (BOX 97, HARTMAN, N. J.)

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-151



Automotive connecting rods are being broached at a 450 per hour rate on a new Colonial ElectroGear dual ram broaching machine. Finish on broached surfaces is definitely superior—tool life is longer. Cutting speed is 45 feet per minute.

Side by side broaching on each ram (balancing pad and locating pads) produces two completed parts with each cycle of the machine.

New Colonial ElectroGear drive broaching machines are made in dual ram vertical and single ram horizontal models. Your Colonial representative can tell you about the new high in broaching performance that you can get with these machines. Write for information.



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-152

part is displaced from its undisturbed condition by cold working until it assumes a desired shape. The entire process takes place in a matter of seconds as one continuous operation. Formed parts have good surface and tooth-strength characteristics.

Roto-Flo machines may be automatically or manually fed. In automatic setups, they can be operated throughout the complete forming cycle without any operator attention.

The unit handles parts with diameters ranging from $\frac{1}{2}$ to 2 in. Rack lengths used are up to 36 in. with maximum stroke length of 42 in. Part lengths from 6 to 36 in. can be accommodated.

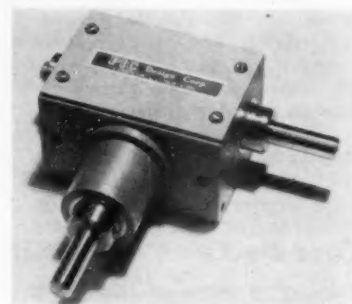
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

T-8-1521

Miter Gearboxes

Type BA precision miter gearboxes, available from stock, are designed for application where right angle precision drives are required.

All material used in construction is



certified under military specifications.

Miter gears are PIC Type N matched pairs to minimize backlash. Units are available in three sizes: $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ -in. shaft size.

PIC Design Corp., 160 Atlantic Ave., Lynbrook, L. I., N. Y.

T-8-1522

Carbide Blanks

A new series of Firlomet cemented carbide blanks include standard reamer, rectangular reamer and solid square tool blanks.

Standard and rectangular reamer blanks are each available in 11 sizes and in 2 grades. The solid square tool blanks range from $\frac{1}{2}$ in. wide, $\frac{5}{8}$ in. high and 1 inch long to $\frac{3}{8}$ x $\frac{3}{8}$ x $1\frac{1}{4}$ in. Cutting edges are hot ground to 10 deg and the blanks are available in 5 sizes and in 4 grades.

Firch-Loach Metals, Inc., Buttermilk Hollow Rd., McKeesport, Pa.

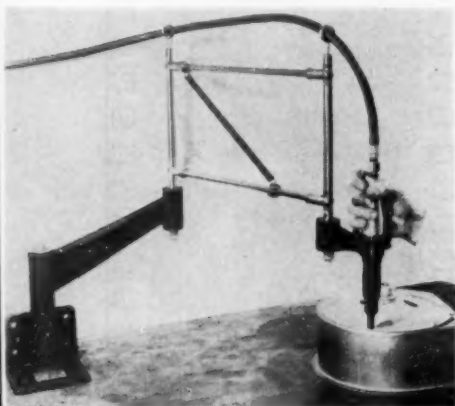
T-8-1523

The Tool Engineer

Tool Mount

This self-balancing tool mount, called Radarm, maintains constant vertical alignment of air and electric portable tools on operations within a 30-in. radius.

The mount is designed with a base which can be attached to any horizontal or vertical surface and can be reversed so that the arm of the mount is suspended from instead of supported by



the base. It also can be mounted on walls or columns along conveyorized assembly lines in order to avoid interference with movement of materials. A balancing mechanism is combined with the tool mount to lower operator fatigue, as well as reduce tool breakage and spoilage of work in process.

A self-aligning clamp automatically adjusts to the contour of the portable tool in use.

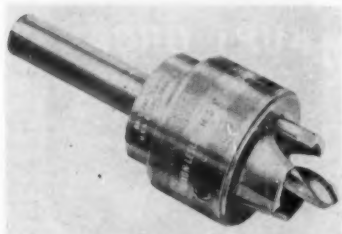
Distributed by Pneuma-Serve, Inc., 19930 Detroit Rd., Cleveland 2, Ohio.
T-8-1531

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Hole Cutter

This high-speed hole cutter is designed for use in 1/2-in. capacity portable or bench type drilling machines.

Bodies range from 3/4 to 2 in. in diameter in 1/4-in. steps. Cutting teeth, of super high-speed steel, can be readily



reground on a 6-in. bench grinder and are easily replaced. Fixed supports for the teeth are designed to give good chip clearance and limit the rate of feed into the metal to approximately 0.004 ipr.

Any of the bodies can be instantly fitted or ejected from the taper end of a common mandrel which is complete with an ejector cap and 1/4-in. HSS pilot drill. Straight and Morse taper shank mandrels are available.

Drilling capacity is up to 7/16 in. while a hole can be cut in material up to 7/8 in. thick by operating from each side in a common pilot hole.

According to the manufacturer, large-size holes can be cut in metal in about the same time as the pilot hole.

Dixon-Lesley, Ltd., 28, St. Mary's Place, Newcastle-on-Tyne, England.

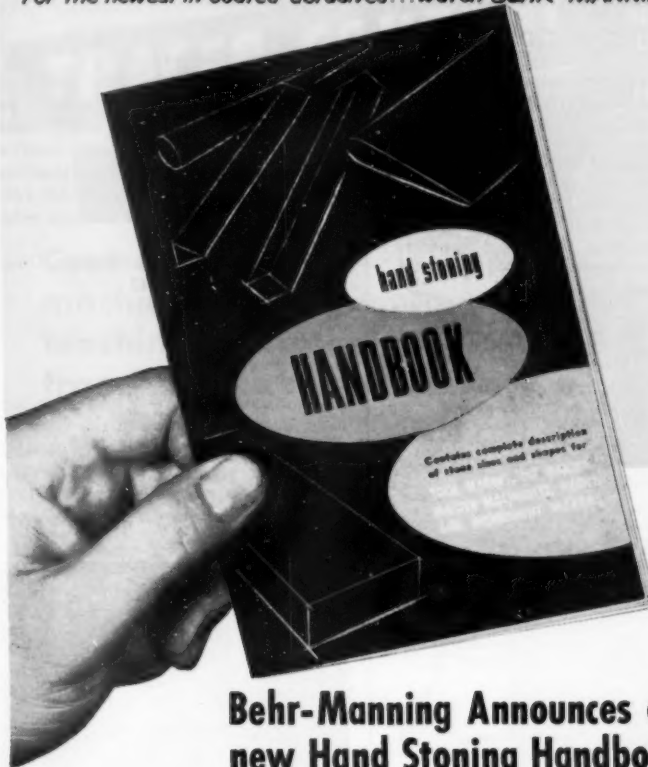
T-8-1532

Seam Welder

Bench type resistance seam welder has adjustable welding current and pressure for welding a range of critical metals down to 0.002 in. The unit may be used on such metals as stainless steels, Inconel, Monel, Hastillon and Nichrome, titanium, Stellite, nickel-silver, beryllium-copper and certain bronzes and brasses.

Formerly produced in special designs only, this compact unit, identified as Type OS, is built on a narrow frame to conserve space. Electrode wheel drive arrangements available include single gear, single or double knurl and single or double friction drive. It can be equipped with circumferential, longitudinal or universal welding head arrangements, using either straddle bear-

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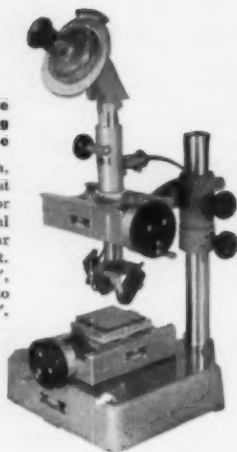
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COATED ABRASIVES
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PRESSURE-SENSITIVE TAPES

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Coordinate Measuring Microscope

High precision, low cost instrument for 2-dimensional linear measurement. Range 2" x 2", reading to 0.0001".



Cut rejects, speed production

Fast, reliable readings to 0.0001" with Gaertner measuring microscopes

Precise, versatile, easy-to-use Gaertner measuring microscopes assure positive, direct measurement of precision parts. You see clear, sharply-defined images. No physical contact to distort or injure object being measured. Enjoy new production savings with Gaertner optical instrumentation. Write for complete data on the Gaertner line of industrial microscopes.



Toolmakers' Microscope

Ultimate in measuring microscopes. Range 2" x 4", reading to 0.0001", angular measurement to 1 minute.



Micrometer Slide Comparator

Reliable, low cost instrument for linear measurement. Ranges up to 4", reading to 0.0001" or 0.00005".



Filar Micrometer Microscope

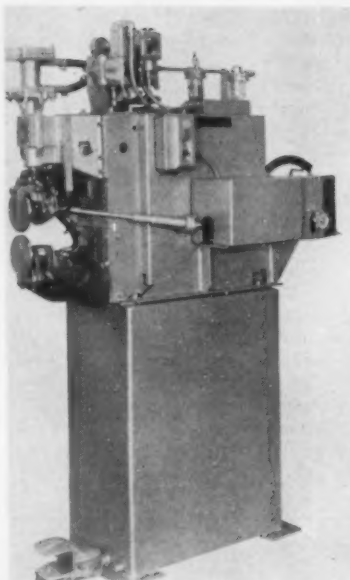
High quality, low cost instrument for extremely precise measurements. Range 0.06", reading to 0.00002".

Write for Bulletin 161-54 showing applications, models, specifications.

The Gaertner Scientific Corporation

1241 Wrightwood Ave., Chicago 14, Ill.
Telephone: BUckingham 1-5335

INDICATE A-8-154-1



ing or cantilever mounts.

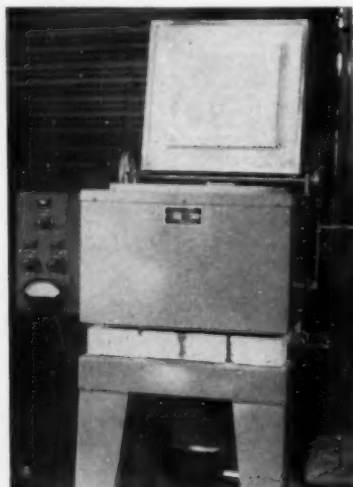
A sub base permits floor mounting. External flood jets, individually controlled, cool the electrodes, and a water drain permits inspection of interior cooling circuits. Antifriction bearings in the welder ram guides provide consistently low friction and uniform welding force.

Taylor-Winfield Corp., Warren, Ohio.

T-8-1541

Firing Kiln

Combination dewaxing and firing furnace, designed for use in the Glascast disposable pattern process, is capable of 2200 F temperatures. A modified top-loading firing kiln dewaxes and fires Glascast molds in one 10-15 minute op-



See how **LINDNER JIG BORER**

direct-reading
micro-optical
measuring system
with "Autopositioner"

speeds initial and
repeat table settings-
guaranteed accurate
within .00015"



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table sizes
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Harborside Terminal Bldg.
Jersey City 2, N. J.

In Canada:
2490 Eglinton Ave. W. Toronto

INDICATE A-8-154-2

The Tool Engineer

eration. Wax recovery from the mold assemblies averages 95 percent.

Removable bottom covers a stainless steel funnel. The wax, melted from the mold assembly, falls through the funnel and is recovered below. The bottom is replaced and the mold is fired. When removed from the furnace, it is ready for casting.

Mold assemblies are inserted in the preheated furnace (1920 F) and hung on a Nichrome frame. Instantaneous heat melts the wax from the mold shell in less than a minute. The wax falls through the bottom of the furnace before reaching ignition temperature.

Corning Glass Works, Corning, N. Y.
T-8-1551

Speed Reducer

A combination speed control, fluid motor, speed reducer incorporates a slow output speed with torque multiplication. A built-in relief valve allows maximum torque input to the speed reducer and prevents overloading.

The low-cost unit is particularly designed for use on any device requiring



variable speed and relatively low power output and feeding attachments. The fluid motor is available with or without a speed control valve.

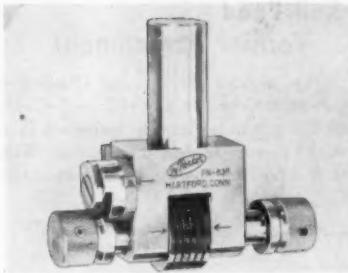
Speed reducers are available in a range of ratios, with speed control valves to handle 0-2, 0-4 or 0-6 gpm. Gear widths are 1/2, 3/4 or 1 in.

John S. Barnes Corp., Rockford, Ill.
T-8-1552

Marking Heads

Automatic numbering heads, that can be furnished with shanks to fit any press, can be quickly set to number consecutively or repeat a setting any number of times. Numbers may be changed easily and accurately without the use of mirrors. Two small arrows point to the number set and they can readily be seen from a standing position.

Design incorporates full stroke swing, oversize shaft, ratchets and pawls, hub



type wheels for easy, long, service-free operation. Custom numbering heads can be ordered with any combination of figures, symbols or codes, for part numbering, coding, or trade mark stamping.

Parker Stamp Works, Hartford, Conn.
T-8-1553

Production Grinder

The 4B61 single head plunge cut Bowgage production grinder incorporates a wheelhead unit that provides automatic grinding with gaging, and rough and finish feeds. Automatic cycle with rapid traverse increases production, saves time and cuts costs.

The wheelhead, mounted on a suitable base, will grind any number of diameters, tapers, shoulders, etc. to close tolerances, automatically. An operator only loads the workpiece and pushes the start button. The machine performs all the operations and then stops automatically for removal and reloading of the work.

It is available in two sizes: 10 x 24 in. and 10 x 36 in. Maximum swing over

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MODELS**

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595 E. Ten Mile Rd., Hazel Park, Mich.

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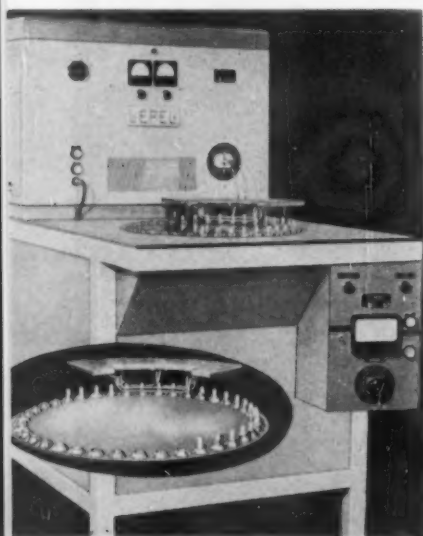
table is 10 in.; maximum diameter grind, 6 in.; maximum distance between centers, 28½ in. Headstock speed range is 50 to 600 rpm; wheelhead spindle speed 830 rpm. Grinding wheel is 30 in. x (¾ to 6 in.) x (12 to 20 in.). Maximum automatic wheel feed is 0.063 in.; rapid traverse is adjustable to 5 in.; grinding feed rates are infinitely adjustable; dwell or spark-out time is 0 to 5 minutes, and angular positioning of wheelhead to 30 deg is possible.

Van Norman Machine Co., Springfield 7, Mass. **T-8-1561**

Accessories for Induction Heating

A line of rotary tables, index tables and conveyor belt units for automatic continuous feed in metal joining and heat treating operations includes the illustrated rotary table. The latter is combined with high-frequency induction heating for assembly of fuse plugs on a continuous-production basis.

Turn tables can be constantly water



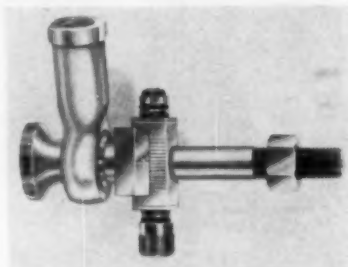
cooled to control the flow of molten fusible alloy without spilling. Rotating plates are quickly interchangeable to save setup time when changing from one job to another. Swing-away remote control box has a speed indicator and provisions for adjusting speed for any application.

The Lepel electronic-tube generator is shown mounted on the rotary table for convenient operation and conservation of floor space. The generator is equipped with a stepless thyatron power control for rapid adjustment to any required temperature.

Lepel High Frequency Laboratories, Inc., Woodside, N. Y. **T-8-1562**

Roll-Feed Vernier Attachment

This vernier adjustment attachment can be attached to any roll feed simply by using it to replace the universal joint in the present feeding mechanism. With it, it is possible to adjust roll feed to any



increment in a few minutes. Adjustment is fast and accurate.

Plus and minus scale of the attachment permits easy reading of the adjusting increment and it is possible to re-adjust the increment quickly without changing the adjustment on the eccentric of the press. Each line of the scale equals 0.008 in. in feeding length.

Durant Tool Supply Co., 136 S. Water St., Providence 3, R. I. **T-8-1563**

Drill Unit

Low cost pneumatic machine tool designed to reduce costs of machining operations which require rotary and feed motions is available for immediate delivery from stock in 1½, 3 and 6 in. strokes.

This tool, designated Model 150 drill unit, is rated ½-in. capacity in steel, and operates at 9000 rpm max. It has a broad application on metals, wood and plastics.

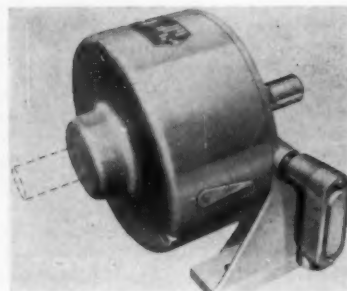
Small size of this new Model 150 unit permits use in confined spaces. It is 2½ in. wide, 3¼ in. in height and 8 11/32 in. in length.

Alkon Products Corp., 200 Central Ave., Hawthorne, N. J. **T-8-1564**

Magnetic Brake

This disk type brake can be mounted separately from a motor while providing the efficient braking advantages of the disk brake. Foot-mounted, these brakes are available with their own self-contained bearings and shaft for applications where a coupling is used between machine and brake, or without a shaft, to permit the extension of the machine's drive directly into the brake.

Design also provides automatic lining wear adjustment, fast, direct-action set



and release without levers or linkage, and manual release with automatic reset. Totally enclosed in a one-piece cast aluminum housing, the brake incorporates a doughnut-shaped magnet which permits extension of the shaft entirely through the brake.

Ratings available are 3, 6, 10, 15 and 25 ft-lb continuous or intermittent duty and 35 ft-lb intermittent duty.

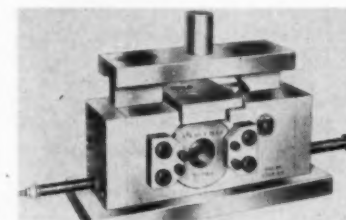
Reuland Electric Co., Alhambra, Calif. or Howell, Mich. **T-8-1565**

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Pipe and Tube Notcher

Clean cutting, accurate alignment and high speed notching of pipe and tubing result from use of the New Arc-Twin.

Cutting from the inside out, this tool leaves clean edges that require no further finishing; 180-deg alignment of



notching is automatic. Reciprocal action of the punch cuts two identical notches with each downstroke of punch press; this operation takes only two or three seconds.

Vogel Tool and Die Corp., 1825-7 N. 32nd St., Melrose Park, Ill. **T-8-1566**

Coolant Pump Motors

Totally enclosed fractional-hp motor, designed especially for driving machine-tool coolant pumps, has a NEMA-C end-shield for direct coupling to the pump. It can be mounted horizontally or vertically, while smooth contours, including a closely fitted dripcover, per-

mit easy cleaning and maintenance.

Large grease reservoirs are factory filled with a grease, highly resistant to moisture and oxidation. Locked ball bearings receive a constant supply of lubricant for ten years' normal operation.

The motor is effectively cooled by conduction and radiation. Internal fans



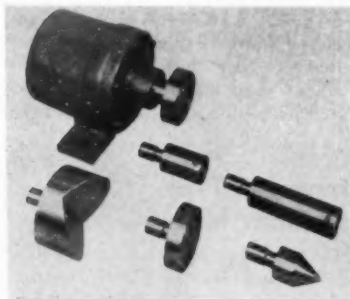
maintain even internal temperatures by circulating air to the cooler surfaces. Rated temperature rise is 55 C.

General Purpose Component Motor
Dept., General Electric Co., Schenectady 5, N. Y. T-8-1571

Universal Air Fixture Lock

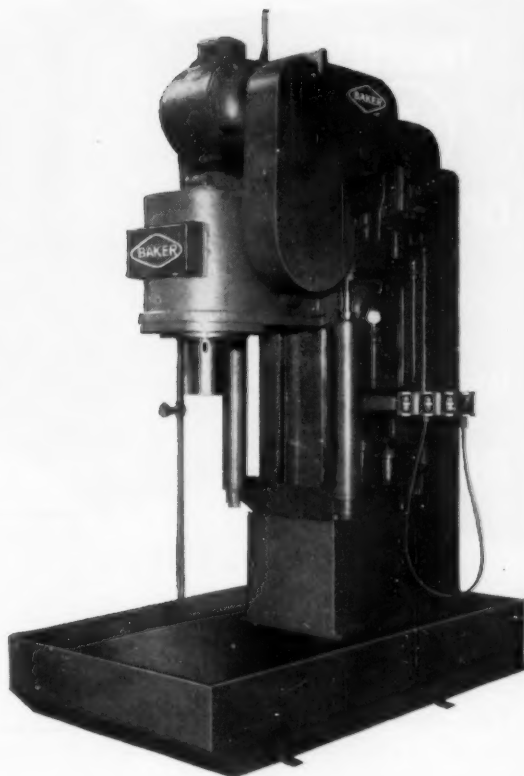
This universal air fixture lock has been designed for instantaneous clamping and can be used on any machine in the plant.

Besides locking workpieces in position, the unit may be used to move one



part of a fixture against another, push workpieces into cutters, load or eject workpieces automatically, press parts into a workpiece or move parts of a machine.

Air cylinder of the fixture lock is machined to receive 5 interchangeable holding tools, which have 1/2-in. under-cut adapter shanks and can be locked



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Yes, it does — when you automate with *standard* Baker Basic machines. They cost much less than a machine specially built for only one part . . . and pay off quicker. For example, a manufacturer recently installed 3 Baker Basics on relatively low-production jobs. He estimates that the savings through automatic operation will pay for the machines in 3 years or less. Ultimately he will incorporate these Baker Basics into a transfer machine. Baker Basics can be retooled with comparative ease and at less expense. They needn't be completely "rebuilt" for a change in product or production method. For drilling, boring, tapping and other machining operations. In 5 sizes.



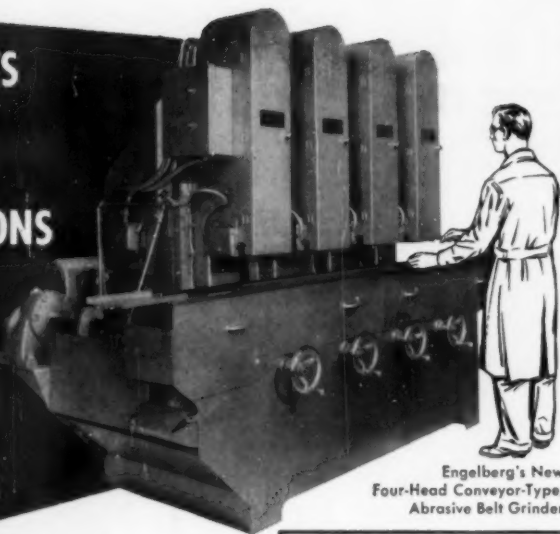
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Engelberg's New
Four-Head Conveyor-Type,
Abrasive Belt Grinder

**Surface, size,
Semi-finish, Fine
Polish...in ONE Pass!**

Talk about high speed production. You will—when you see Engelberg's new multi-head conveyor-type abrasive belt grinder precision size and fine finish any ferrous, non-ferrous, plastic or other flat surface. *With one machine—one operator—and one pass—you can now complete four different grinding and polishing operations.*

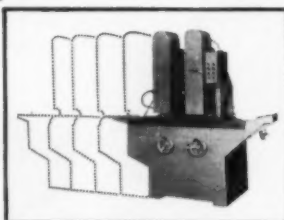
Think of the costs you can slash on high-volume runs. Think of the time you can save on set-ups and changeover. And the initial cost is far less than you'd have to pay for separate machines.

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Choice of 1 through 6 grinding heads
with 6", 8", 10" or 12" belt width.

Parts Finished in ONE Pass



Chain Saw Bars—4 head operation removing .004" per head for total .016" per pass with conveyor belt speed of 6' per min.

**Roger Dean
FORD**

Name Plate—3 head operation using #240, #320 and #500 grit abrasive belts with conveyor belt speed of 14' per min.



Skate Blades—5 head operation using #120, #180, #240, #320 and #500 grit abrasive belts at 12' per min. conveyor belt speed.



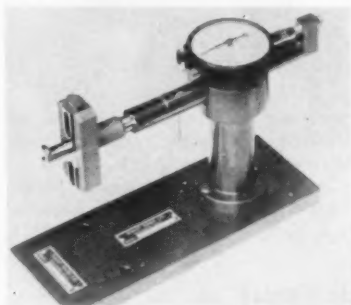
Rubber Tile—3 head operation using #240, #400 and #600 grit abrasive belts with conveyor belt speed of 21' per min.

in place with a 3/32-in. socket set key. The cylinder can be mounted in any position, moved from job to job and used with any of the five holding tools, or with specially made holding tools. Cylinders come in three sizes, with rated locking forces from 650 to 2300 lb and power strokes from 1 1/8 to 3 1/8 in. **T-8-1581**

Dial Bore Gages

Thousand Series dial bore gages, providing one basic gage covering a range from 1/4 to over 5 in., utilizes economical interchangeable tips for checking bores, shallow counterbores, grooves, threads, reliefs, splines and gears.

Basic gages have a pistol-grip design, are of light, sturdy construction, well-balanced and easy to hold. They provide



0.0001-in. dial indicator readings with instantaneous centralization and limited, or no, rocking. Micrometers, gage blocks or rings may be used for master settings. Retractable tips have a straight-line expansion of 0.260 or 0.400 in. at any of the infinite number of settings.

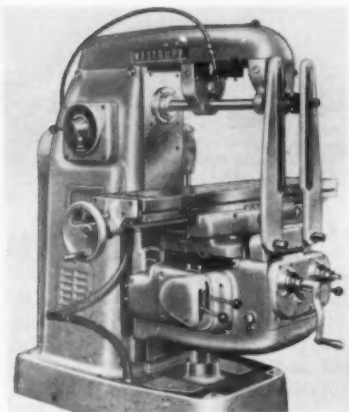
Normally furnished as a portable instrument, the tool can easily be converted to a bench instrument.

Rimat Gage Co., 21 W. Dayton St., Pasadena, Calif. **T-8-1582**

Universal Type Milling Machines

The Westbury line of universal dial type milling machines are designed with hardened and ground spindle and gears, tapered roller bearings and hand scraped ways. In operation, they offer power, speed and precision control.

Three horizontal units are included in the line (1-U, 2-U and 3-U) and feature heat-treated, hardened chrome-nickel spindle with all working parts designed to withstand an overload of more than 100 percent. A single lever operates both the multidisk clutch and



brake for the spindle control. Twelve spindle speeds, from 28 to 1100 rpm, are available with dial and hand control for selecting and reversing. Power is transmitted from the spindle gearbox to the feedbox in the knee through a vertical shaft mounted on tapered roller bearings.

Feeds are selected by dial with a single hand control. All movements can be controlled and operated separately or simultaneously. A tapered clutch permits a single level to engage the rapid traverse to the longitudinal, transverse and vertical feeds.

Distributed by Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y.
T-8-1591

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Metal Cleaning Unit

A batch type mechanically agitated Aja-Lif cleaning machine called Roll-O-Matic Metal Laundry, automatically washes, rinses, rust-protects and dries small metal parts.

It removes oils, industrial soils and

loose chips without hand scrubbing or air blow-off.

Parts to be treated are loaded in a revolving drum, attached to an air cylinder, rotated in the wash solution for a predetermined period, spray rinsed, then antirust treated and hot air dried. Washing and antirusting solutions are salvaged for reuse. After completion of the final liquid or dry stage the drum is automatically raised.

Dept. TE, Magnus Chemical Co. Inc., Equipment Div., Garwood, N. J.
T-8-1592

Ceramic-Tipped Cutters

These cutting tools, called Keramik, have an oxide-base ceramic tip bonded to a steel shank.

The tool material is presently available in a standard size of $\frac{1}{2}$ by $\frac{1}{2}$ by $3\frac{1}{2}$ in. (BR-8-M and BL-8-M) with a lead angle of 7 deg. Custom tipping can be done.

When properly ground, Keramik tools will produce a finish comparable to a commercial grind. They may be operated either at fast or slow speeds, and



Infinite Variety

LODDING RETRACTING CLAMPS

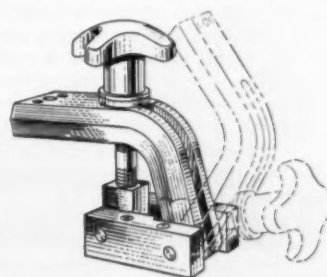
Lodding Retracting Clamps lend themselves to infinite variation. Jaws are added to suit work. Tapped and clear holes are there for you to use. Lodding provides four types of action—and your own imagination is the limit to the variety of jaws you can add. Four sizes each of four styles—hand knob, hand cam, nut and air operated.

LODDING, INC.
Worcester 1, Massachusetts

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Los Angeles 3, Calif.	Evanston, Ill.

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A New Principle of AUTO-COLLIMATION



THE
DAVIDSON
MODEL D-600

COMPARISON AUTOCOLLIMATOR

This new type angle-comparator permits accurate and repeat measurement of the difference in angle of the returning beams to 1/10th second of arc.

It allows comparison and measurement of small angles to a precision heretofore considered impossible.

Patented design, employs a unique arrangement of optical tipping plates coupled to a calibrated micrometer dial.

Any change in position of the D-600 moves the compared images in the field of view but has absolutely no effect on the micrometer reading.

We gladly discuss optical measuring problems.



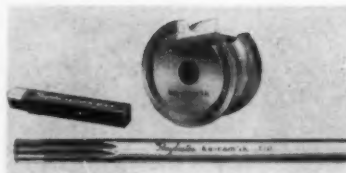
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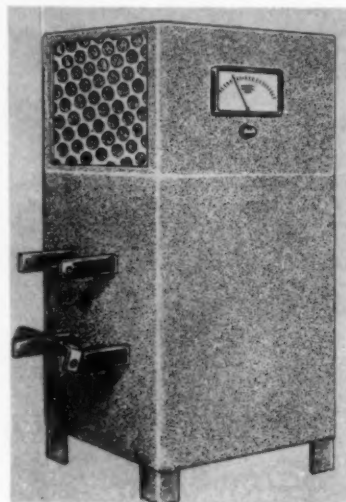


no cutting oils are necessary. The cutting tip runs cool and chips will not weld to it. Because of low thermal conductivity, there is no build-up on the cutting edge and no cratering. In addition, the cutting tool is nonabsorbent, and unaffected by corrosion.

Raybestos Div., Raybestos-Manhattan, Inc., Bridgeport, Conn. **T-8-1601**

Germanium Rectifiers

Germanium electroplating rectifiers, developed for metal finishing, are fully protected against circuit overloads. Utilizing the General Electric germanium Safety Cell, hermetically sealed to protect the germanium wafer from the deteriorating effects of moisture and



corrosive fumes, the rectifiers have permanent characteristics and will not age.

Basic stacks consist of six germanium cells, each with cooling fins. The stacks are of a standard design, are interchangeable and are rated at approximately 500 amp each. Each cell is individually protected against circuit fault conditions and sudden overloads by fast-acting "amp trap" fuses which break circuit in a fraction of a second.

All units are forced air cooled. The 3-phase blower motor has a separate magnetic starter to guard against overloads. A pressure switch further protects the unit from build-up of destruc-

tive temperatures due to blower failure.

The rectifier also is protected against single phasing on the 3-phase circuit. The main magnetic starter is provided with a thermal breaker for overloads.

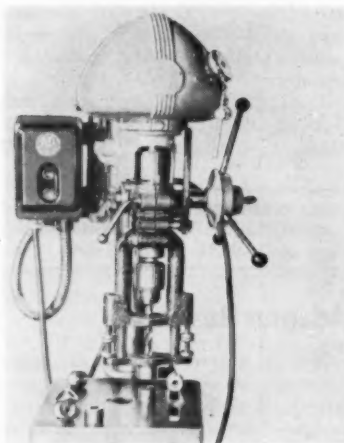
Efficiencies as high as 95 percent are possible and units will operate indefinitely at up to 150 percent of rated current. Voltage range is from 6 to 48, with current output up to 50,000 amp. The rectifiers are provided with any popular type of automatic or manual control.

Two basic cabinet sizes are available: 28 x 28 x 64 in. for up to 3000 amp, and 28 x 54 x 64 in. for units with capacities from 4000 to 6000 amp.

Wagner Bros., Inc., 400 Midland, Detroit 3, Mich. **T-8-1611**

Drill Press Attachment

Problem of drilling, counterboring, chamfering or reaming in the exact center of any round, square or hexagon bar is simplified with this drill press attachment called the Center Master. Through the use of a top collar which goes over the quill and insertion of the proper bushing, the attachment will fit any type or size drill press. No holding device is necessary because a bell bush-



ing accurately locates and locks the work in position. Spring pressure on the bell gives adequate holding power.

The bell bushing can be removed and a V-block placed in the bottom plate in preparation for drilling a cross hole in the stock. The V-block holds securely without additional holding devices, and can be designed to locate a hole in any part and at any angle desired.

Shop workers without special skill can produce accurate parts at good production rates with this device.

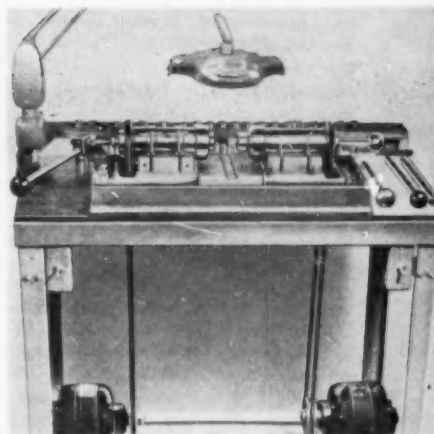
Center Master Corp., 3757 S. Kinickinnick Ave., Milwaukee 7, Wis.

T-8-1612

Horizontal Drilling Unit

Consecutive hole finishing operations, with multiple tooling, may be accomplished with this horizontal drilling machine without removing the workpiece from the machine or individual tools from the tool quills. One model of the unit machine drills holes axially through a cylindrical part while, with suitable attachments and modifications, another model can be used to finish holes on rectangular coordinates to an accuracy of ± 0.0005 in. Multiple tool quills allow a series of operations—including drilling, chamfering, reaming, etc.

These machines also have collets, chucks or special work holding fixtures on the head stock. Quill drive is through



GUIDE PINS and GUIDE PIN BUSHINGS

Because high production, quality control and longer die life have become all-important, most stamping plants have now standardized on Lamina guide pins and Lamina bronze-plated bushings.

All Lamina wring-fit bushings are pre-finished on the I.D. Seated on a ground shoulder square with the surface of the die shoe and secured by special retainers, they assure distortion-free, full bearing surface that results in better die alignment, less maintenance and longer die life. Lamina guide pins are special tool steel, heat treated, spray quenched, ground and burnished. The uniform, hard surface resists wear and the tough core prevents bending during installation or use. The pins are dimensionally accurate, do not "mushroom" or get out of round, and require no "running in".

There is a type and size Lamina Guide Pin and Bushing for every need. Our new catalog gives illustrations, applications, dimensions and prices of more than 800 items. Write for free copy.



LONG SHOULDER TYPE—Small toe clamp. Use to keep guide pin in bushing during strokes. Long wearing bronze plated on hardened steel, $\frac{1}{4}$ " to 3" pin dia.



HEAVY DUTY—Large toe clamp, for large and heavy die sets requiring extra body and shoulder thickness. Bronze plated $2\frac{1}{2}$ " to 3" pin diameter.



NUT TYPE—For wide range of requirements. Available in 5 sizes, 1" to 2" pin diameter, long wearing bronze plated on hardened steel.



LONG SHOULDER TYPE—Large clamp. Long bearing surface contains pin during entire strokes, 2" to 3" pin diameter. Bronze on steel.



SHORT SHOULDER TYPE—For die space, more bearing area within die area. Bronze on steel or solid Ampco Brasses. 7 lengths, pin sizes $\frac{1}{4}$ " to 2".



RING CLAMP TYPE—For heavy duty and bonded die sets. Bronze plated steel or Ampco Brasses, 4 lengths, pin diameter $2\frac{1}{2}$ " to 4 $\frac{1}{2}$ ".



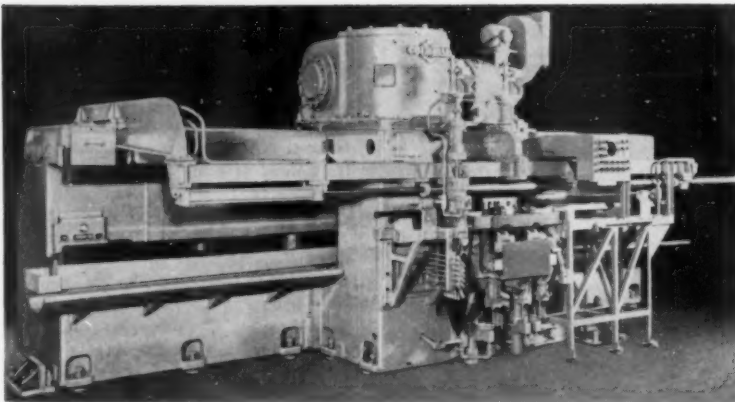
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-161

an adjustable ball bearing friction device that allows free axial movement of the quills while giving the necessary tangential friction to drill holes up to $\frac{1}{4}$ in. without undue slippage.

Jedco, Inc., Micro-Drill Guide Div.,
3980 Superior Ave., Cincinnati 36, Ohio.
T-8-1621

Horizontal Broaching Unit

Parts are automatically transferred into and out of the work station of this Model 60-90 ElectroGear horizontal broaching machine which has infinitely adjustable ram speed from 30 to 150 sfm. Work moves through the broach-



Efficiency in Cutting-off is Important

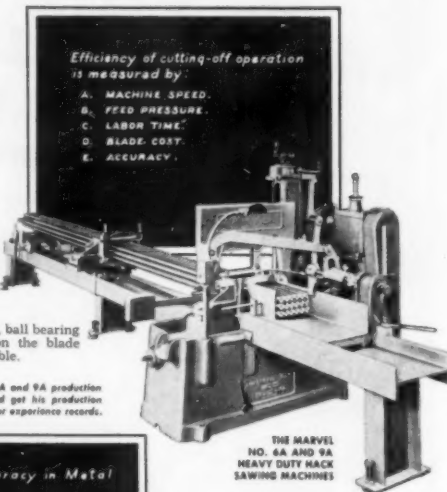
Practically all machining operations start with pieces cut-off from bars or billets. Hence, inefficiency, or lack of capacity, in the cut-off department can hold up or stagnate the entire plant.

- Are all-ball-bearing and provide a quick return; therefore they run **FASTER** than others on the same work.
- Can apply as much as 1200 pounds feed pressure—two to ten times as much as other hack saws and band saws.
- Are fully automatic, requiring no more operator attention than an automatic screw machine; and set-up for any bar size and cut-off length is extremely simple.
- Use a non-breakable high speed hack-saw blade—the type of saw blade that produces the greatest number of square inches of metal cut per dollar of blade cost—two to ten times (or more) as much as any band saw.
- Because of their exceptional sturdiness, ball bearing reciprocating frame, ability to tension the blade "truly taut", their accuracy is dependable.

If you are not using modern, improved MARVEL NO. 6A and 9A production hack saws, call the local MARVEL Field Engineer and get his production and cost estimates on your work—to compare with your experience records.

Efficiency of cutting-off operation is measured by:

- MACHINE SPEED.
- FEED PRESSURE.
- LABOR TIME.
- BLADE COST.
- ACCURACY.



THE MARVEL
NO. 6A AND 9A
HEAVY DUTY HACK
SAWING MACHINES

Formula for Accuracy in Metal Sawing:

$$\text{ACCURACY} = \left(\frac{\text{Length}}{\text{Straightness}} \right) \left(\frac{\text{Straightness}}{\text{Squareness}} \right) \left(\frac{\text{Blade Rigidity}}{\text{Blade Tautness}} \right)$$



The composite MARVEL High-Speed-Edge Hack Saw Blade—cuts any machinable material efficiently. There is no time lost changing blades for different types of steel; no time lost replacing shattered blades, because MARVEL High-Speed-Edge Hack Saw Blades are positively **unbreakable**. These superior blades have the finest high speed steel cutting edge welded to a strong alloy steel body. They will stand-up under the highest speeds and heaviest feeds attainable on any make hack saw. Can be safely tensioned tauter than any other blade—cut-off not only straight but also square and with less stock loss.

Write for catalog C-35—showing and describing eleven different series of Metal-Cutting Sawing Machines and MARVEL High-Speed-Edge Hack Saw Blades and Holesaws.



ARMSTRONG-BLUM MFG. CO. 5700 West Bloomingdale Avenue • Chicago 39, U.S.A.
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-162

ing station from right to left, in the same direction as the cutting stroke of the broach. Entire broaching cycle is automatic and does not require an operator.

Power for the ram is supplied by a direct-current motor served by a motor-generator set. The driving motor is coupled to a gear box containing a Cone-Drive double enveloping worm gear set driving a precision helical pinion. The pinion drives a rack mounted directly to the ram.

All hydraulic and electrical controls are interlocked and installed in accordance with JIC standards. A jog control panel is provided for machine setup and tryout runs.

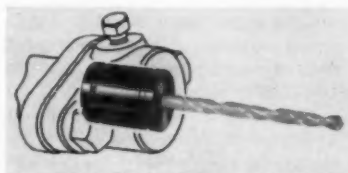
Colonial Broach & Machine Co., P.O. Box 37, Harper Station, Detroit 13, Mich.
T-8-1622

USE READER SERVICE CARD ON PAGE 165 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Adapter Bushing

Nonslip adapter bushings for either automatic screw machine and turret lathe rigid or floating type holders are designed with split type construction so that they clamp their entire length. Because of this they exert tremendous gripping power with low clamping screw pressure. Split design also permits tools to be easily removed from holders for quick setup or grinding.

Two flat spring collars keep the bushing halves in alignment, while spring tension permits precision setting of



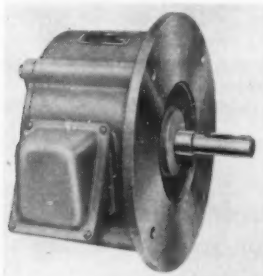
tools with gages before tightening the clamping screw. Sizes include $\frac{1}{2}$ in. diam ($\frac{3}{8}$ to $\frac{3}{4}$ in. in 64ths, A to U, 1 to 40); $\frac{3}{8}$ in. diam ($\frac{1}{8}$ to $\frac{1}{2}$ in. in 64ths, A to Z, 1 to 30); and 1 in. diam ($\frac{1}{8}$ to $\frac{1}{2}$ in. in 64ths, A to Z, 1 to 20). Other sizes, including $\frac{3}{4}$, $1\frac{1}{4}$, $1\frac{1}{2}$ and 2 in. are available on special order.

Marcellus Mfg. Co., Belvidere, Ill.
T-8-1631

Flat Type Motor

Flat type motor, designed to meet specifications for NEMA design B motors was developed for use in the machine tool and equipment industries for applications where there is minimum space. It is available either in totally enclosed fan-cooled or totally enclosed nonventilated designs.

Weighing considerably less than standard motors, the flat type units are of standard radial design, constructed like conventional squirrel-cage motors. Easy to disassemble and easy to re-



assemble, there are no precision alignments or complicated air-gap adjustments. Design feature is that the rotor weight is evenly supported between two ball bearings.

Operating at 208, 220/240 or 550 volts, 2 or 3 phase at 60 cycles, continuous or intermittent duty, the motors are available in ratings ranging from $\frac{1}{8}$ to $7\frac{1}{2}$ hp. They are also available for special voltages.

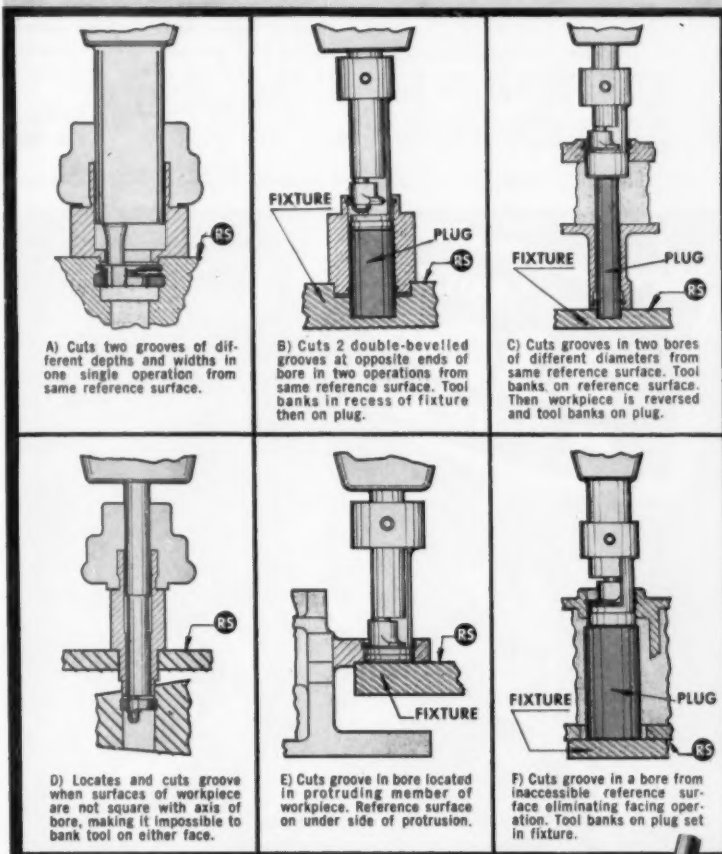
Diehl Mfg. Co., Finnerne Plant, Somerville, N. J.
T-8-1632

Adjustable Toolholders

Three new, adjustable toolholders include a drill holder for automatic and hand screw machines, a nonreleasing tap holder for automatics and a releasing tap holder for hand machines.

Their design utilizes a pair of independently mounted sliding jaws which provide 4-point holding for strength. The jaws move in a vertical direction to accommodate every size tool within the capacity of the machine for which the holder is designed. Horizontal float pro-

Even Unskilled Labor Can Use This Versatile Tool Accurately! It Simplifies Internal Grooving Problems, Cuts Production Costs!



Amazingly versatile! Your toughest recess cutting problems can be met simply and efficiently with the Waldes Truarc Grooving Tool because it offers a whole range of possibilities beyond the range of ordinary recessing tools.

Wide Cutting Range! The Waldes Truarc Grooving Tool comes in 5 models...enabling you to cut accurate grooves in housings with diameters from .250 to 5.00 inches.

Send Your Problems to Waldes! Send us your blueprints...let Waldes Truarc Engineers give you a complete analysis, price quotation and delivery information on the most economical tool set-up for your particular job. There is no obligation!

Write NOW for a 20-page manual containing full information on Waldes Truarc Grooving Tool



**WALDES
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Made by the Manufacturers of Waldes Truarc Retaining Rings
WALDES KOHNOR, INC., 47-16 Astor Place, L. I. C. 1, N. Y.

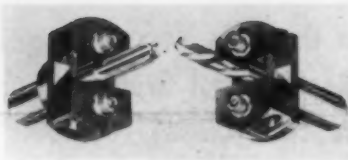
Waldes Truarc Grooving Tool Manufactured
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TE-088
Waldes Kohnor, Inc., 47-16 Astor Pl., L. I. C. 1, N. Y.
Please send me your new 20-page technical manual on the Waldes Truarc Grooving Tool. (GT-2-53)

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vides easy, accurate centering.

With these toolholders, bushings and collets are unnecessary. Because drill holder shanks are hollow, there is no need to cut off tool shanks. Shanks need

not be cut off for use in the tap holders. Only the top jaw is unlocked to remove the tool.

Both the drill holders and the non-releasing tap holders can also be used as reamer holders. A float is provided in both types of tap holders for greater accuracy in tapping and reaming.

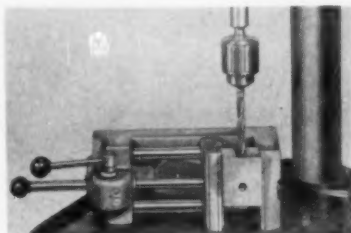
Special jaws with locking screws recessed flush with the outer face of the jaws are available in the two smaller sizes for very close work.

RoyEl Tools, 4221 Exelsior Blvd., Minneapolis, Minn. **T-8-1641**

Three-Sided Vise

Jaw sides of this Model TS (three sided) Grip-Master vise and fixture base are precision-ground parallel to each other and at right angles to the base for accurate machining from top and sides without resetting work.

The vise is offered in two sizes with 3 or 4-in. jaw widths and with a choice

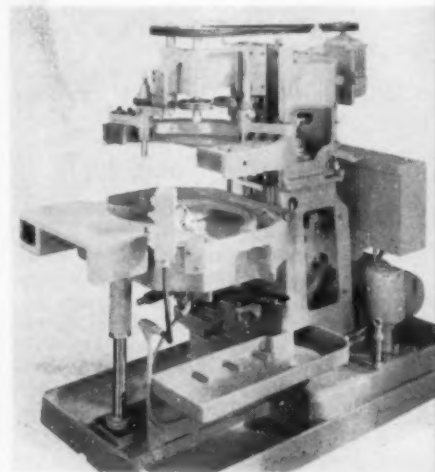


of either the standard SV locking mechanism for general vise and fixture work, or with the PA series locking mechanism which enables the operator to advance the jaw forward by pumping the locking lever. The Grip-Master locking mechanism on the vises permits high-speed operation, particularly when handling small parts.


Heinrich Tools Inc., Racine, Wis.
T-8-1642

Basic Machine For Special Tooling


Basic machines and tooling components are available either separately or in any combination to permit users to design and assemble their own special machines with minimum engineering and time loss. The basic chassis is available in four sizes which can be tooled for a broad range of work by the simple



Accuracy $\pm .000008"$
\$320.00
84 BLOCK SET



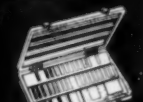
For years Webber has dedicated itself to the production of gage blocks at a price that even the smallest shop can afford. Quality and precision have not been compromised in this undertaking. Ask those who use them. Write for literature.

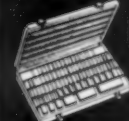

 H. D. BLOCKS
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Webber

GAGE COMPANY

12908 Triskett Rd.
Cleveland 11, Ohio


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LARGEST EXCLUSIVE MANUFACTURER OF PRECISION GAGE BLOCKS

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Literature Number	COMPANY	DESCRIPTION
A-8-142	Allegheny Ludlum Steel Corp.	Tool Steels—Technical and shop data on the Carmet "CA-800" series of special steel-cutting carbides available. (Page 142)
A-8-36	American Broach & Machine Co.	Broaching Machines—"American" Catalog 450 contains data on broaching operations. (Page 36)
A-8-208-2	American Cystoscope Makers, Inc.	Borescopes—Booklet contains practical information on the use of Borescopes in industry. (Page 208)
A-8-157	Baker Brothers, Inc.	Special Machines—Catalog contains information on Baker basic machines. (Page 157)
A-8-214-1	Barksdale Valves	Air Valves—Information on 4-way air valves for 250 P.S.I. contained in bulletin A-5. (Page 214)
A-8-174	Barnes Drill Co.	Honing Tools—Catalog 500A contains data on honing tools and abrasives. (Page 174)
A-8-153	Behr-Manning	Hand Stoning—Handbook contains description of stone sizes and shapes of the line of oilstones. (Page 153)
A-8-37	The Bellows Co.	Air Motors—Bulletin BM-25 gives data and specifications on Bellows air motors. (Page 37)
A-8-186	Bealy-Welles Corp.	Carbide Tools—Catalog 852C contains data on throwaway carbide inserts; Catalog 851C on carbide blanks. (Page 186)
A-8-22	The Blanchard Machine Company	Surface Grinding—Two booklets on surface grinding contain data on application of Blanchard grinding. (Page 22)
A-8-27	The Bullard Company	Special Machines—Catalog describes new Man-Au-Trol V.T.L., Model 75. (Page 27)
A-8-53	Crucible Steel Company of America...	High Speed Steels—"Crucible Publication Catalog" on application of Rex tool steel available. (Page 53)
A-8-39	The Cushman Chuck Company	Work Holders—Catalog describes Cushman air operated chucks and cylinders. (Page 39)
A-8-216	The Denison Engineering Company	Hydraulic Pumps—Bulletin P-5-A contains specifications on 4 sizes available for delivery up to 77 gpm as a pump and 1 to 103 hp as a motor. (Page 216)
A-8-195	Detroit Die Set Corp.	Die Bushings—Bulletin 56 contains data for die bushing selection. (Page 195)
A-8-63	Eastman Kodak Company	Contour Projectors—Booklet gives details on Kodak optical gaging equipment. (Page 63)
A-8-9	Federal Products Corp.	Indicators—New Dial Indicator Catalog No. 55 and Price List available. (Page 9)
A-8-54	Keller Tool Division Gardner-Denver	Tool Balancers—Catalog Section 65 gives data on Keller tool balancers. (Page 54)
A-8-178	Lapeer Manufacturing Co.	Hand Clamps—Catalog contains engineering specifications and models available. (Page 178)
A-8-41	Logansport Machine Co., Inc.	Machine Circuit—"Circuit Rider" booklet contains data from the simplest to the most complex circuit designed by Logan. (Page 41)
A-8-218-1	Lovejoy Tool Company, Inc.	Cutting Tools—New catalogs available: No. 31 (Face Mills), No. 32 (Side Mills), No. 33 (Arbors). (Page 218)
A-8-186	Melin Tool Company, Inc.	Cutting Tools—Catalog No. 54-C lists the specifications on all inclusive Stub Length Tools. (Page 186)

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A-8-189	Oakite Products, Inc.	Metal Cleaning—Copy of "How to clean metals in aircraft production" available. (Page 189)
A-8-06	The Ohio Crankshaft Co.	Motor Generator—"TOCCO High Frequency Motor-Generator Sets" bulletin available. (Page 60)
A-8-209	The Ohio Knife Co.	Special Metal—For bulletin "Slitting—A Basic Guide for the New Operator," write Dept. 12-U. (Page 209)
A-8-146	Tinius Olsen Testing Machine Co.	Testing Machine—Bulletin 52 contains data on Olsen Air-O-Brinell testing machine. (Page 146)
A-8-185-2	Ortman-Miller Machine Co.	Cylinders—Catalog showing cylinders and complete line of mounting brackets, available. (Page 185)
A-8-208-1	Pangborn Corp.	Hydro-Finish—Bulletin 1403 contains data on Pangborn Hydro-Finish. (Page 208)
A-8-202-3	Petz-Emery, Inc.	Dial Indicators—Bulletin 455-D contains data on the new Em-re Precision Dial Indicator. (Page 202)
A-8-34	Rehnberg-Jacobson Manufacturing Co..	Machine Attachments—Catalog contains information and specification sheets on all types and sizes of R-J drill, tap and index units. (Page 34)
A-8-223	The Rotor Tool Co.	Air Tools—Bulletin 43 contains operational data on the Rotor tool line. (Page 223)
A-8-199	Sciaky Bros., Inc.	Welding Machines—Sciaky Predetermined Electronic Counter Weld Control is described in Bulletins 338 and 339. (Page 199)
A-8-150-1	Standard Parts Company	Fixture Components—Catalog illustrates line of jig and fixture parts. (Page 150)
A-8-59	Unbrako Socket Screw Division Standard Pressed Steel Co.	Socket Screws—Technical data and specifications are detailed in Bulletin 2193. (Pages 58-59)
A-8-40	The L. S. Starrett Company	Measuring Instruments—New Catalog No. 27 shows the complete Starrett line. (Page 40)
A-8-172	Tomkins-Johnson Company	Cylinders—Bulletin SM-155-3 gives engineering specifications on the T-J line. (Page 172)
A-8-52	The Torrington Company	Swaging Machines—Catalog gives specifications of new Rotary Swaging Machines. (Page 52)
A-8-232-3	Union Gage Corp.	Flush Pin Gages—Catalog contains data on Standard Flush Pin Gages. (Page 232)
A-8-232-2	The Vaill Engineering Co.	End-Forming Machines—Bulletin T-1 shows and describes the versatility of Vaill Tube End-Forming Machines. (Page 232)
A-8-33	Vascoloy-Ramet Corp.	Metal Cutting—Tool Selector Chart available; also catalog containing data on V-R Tantung cast alloy cutting tools. (Pages 32-33)
A-8-222-1	S. B. Whistler & Sons, Inc.	Magnetic Dies—Catalog describes Whistler Magnetic Dies and illustrates simplicity of set-up. (Page 222)

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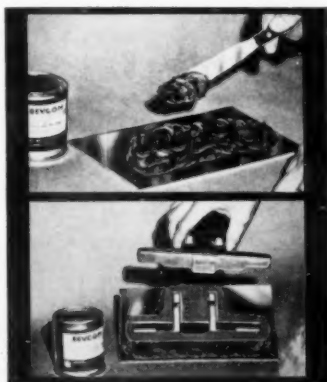
The Plastic Steel

For making jigs, fixtures, forming dies, molds, models and rebuilding machinery

80% STEEL
20% PLASTIC



DEVCON makes a precision form of the original . . . without shrinkage or distortion. DEVCON handles like modeling clay . . . hardens to strong, tough, metallic piece in two hours . . . can be sawed, tapped or ground with metal-working tools. No heat or pressure is required — unaffected by most solvents, oils, and chemicals.



DEVCON saves money in repairing and rebuilding machinery, tanks and equipment . . . large or small holes in castings can be filled . . . worn pumps and valves built up for longer use. DEVCON bonds to itself, steel, iron, aluminum, brass, bronze, wood, porcelain and many other materials.

DEVCON is available in four types — write for descriptive Bulletins. Distributed nationally by leading industrial suppliers.



CHEMICAL DEVELOPMENT CORP.

300 Endicott Street, Danvers, Mass.

INDICATE A-8-167-1

August 1956

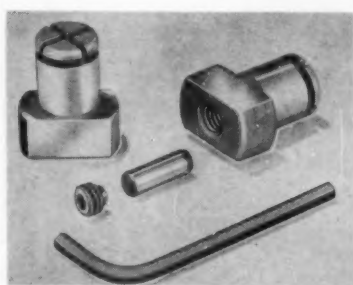
arrangement of standardized indexing, feed and spindle units.

All operations are mechanically interlocked, avoiding need for complicated air feeds and electrical interlocks. Once the machines are built and in operation, they will be serviceable with off-the-shelf standard inspected parts.

The Bodine Corp., Bridgeport, Conn.
T-8-1671

Sine Fixture Key

Design of this key is such that five operations normally required during the milling of key slots in fixture bases can be avoided. Layout and milling savings can be large. Stemmed con-



struction enables use of a bored hole in lieu of the standard milled slot; thus there is no need for the usual milling and setup operations. The new sine fixture keys are interchangeable and are complete with self-contained locking device.

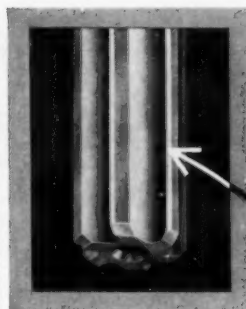
Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, Ohio.
T-8-1672

Gear Profile Measuring Unit

A compact portable gear profile measuring instrument, designed by the David Brown Tool Div. of Huddersfield, England, for use on large diameter gears where accuracy of profile must be precisely maintained, covers gears ranging from 18 in. to 16 ft in diameter. It may be used efficiently to test spur or helical gears.

The instrument is mounted on the gear by three spherical locators; six sets of these locators, ranging from 5/16 to 3/4 in. in diameter, are supplied with each instrument to accommodate gears of various pitches. Horizontal and vertical slides can be set in any desired position to within 0.0001 in. The vertical slide carries a spherical-ended stylus which operates a dial indicator graduated in ten-thousandths.

The method employed to check the accuracy of the gear profile is based on



This edge cuts reaming costs



L+I gives you the edge on production

Call your L+I distributor

The Reamer Specialists



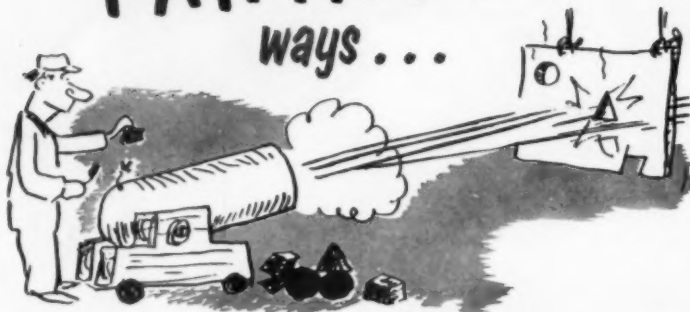
LAVALLEE & IDE, INC.

CHICOPEE, MASS.

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167

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FANTASTIC
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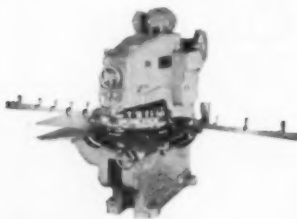


to Produce Holes
 in Flat Sheet Metal and Plate

. . . but cost conscious production men
 use **WIEDEMANN**
Turret Punch Presses

You will save money with a Wiedemann on your short run piercing operations. In fact, a Wiedemann will cut your piercing costs 60% to 90%—because a Wiedemann means . . . no set up . . . no layout . . . reduced handling . . . low cost, on-the-spot engineering changes.

It will pay you to get the facts about the Wiedemann Method. Write today for Bulletin 101, or, better yet, send typical drawings of your work for a free time study and a recommendation of the press and tooling best suited for your needs.

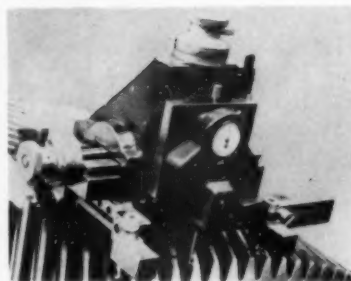


From the small, hand operated R-2 to the 150-ton Turret Punch Press, there's a Wiedemann designed for your short run piercing needs.

WIEDEMANN MACHINE COMPANY

4245 Wissahickon Ave. P.O. Box 6794 Philadelphia 32, Pa.
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168



the measurement of a series of predetermined horizontal and vertical coordinates.

Represented in U. S. by Morey Machinery Co., Inc., 383 Lafayette St., New York 3, N. Y. **T-8-1681**

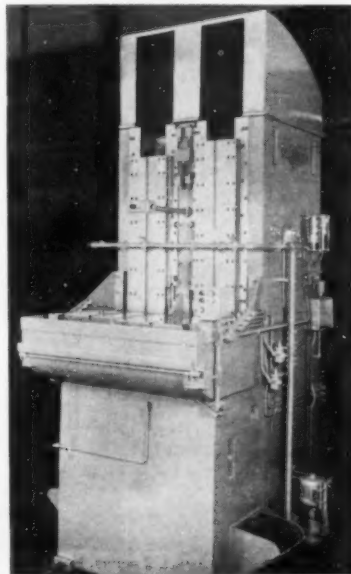
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Broaching Machines

Line of 15-ton capacity ElectroGear dual ram vertical broaching machines has smooth operation because of helical pinion rack drives and balanced power loading. This smooth flow of power to the tool results in good finish with fast cutting strokes. The pinion-rack drive is powered by a variable speed d-c motor powered by a motor generator set. While one ram is on the cutting stroke, the other ram is returning.

Five basic models are available with stroke lengths of 54, 66, 80, 90 or 100 in. Broaching speeds are available up to 80 fpm or faster.

Massive, internally ribbed construction also contributes to smooth operation.



The Tool Engineer

tion of all machines in the line, resulting in increased broach life. Ram speed is infinitely variable between minimum and maximum limits to give optimum broaching speeds for any particular operation or material.

Ram ways are pressure lubricated and gears are automatically lubricated. Work-holding fixtures, interlocked with the machine cycle, are hydraulically operated.

All hydraulic and electrical controls are interlocked and installed in accordance with JIC standards. Tables and fixtures are hydraulically actuated.

Colonial Broach and Machine Co., P.O. Box 37, Harper Sta., Detroit 13, Mich. **T-8-1691**

Automatic Injection Molder

Two-ounce automatic vertical injection molding press, Model 701, combines vertical clamping with a horizontal combing action. De-gated parts can be ejected horizontally onto a conveyor, reducing the danger of surface damage. Barriers can be incorporated into the horizontal comb to guide into separate bins the separate pieces of a multiple-piece mold, as well as the sprues and runners.

Vertical configuration of the machine simplifies mold setup, and handling of inserts under semiautomatic operation is easier. Molded pieces may be ejected either from top or bottom. Knockout cylinders are hydraulically operated, independent of the moving ram.

Hot runner molds provide positive shutoff at the mold. This permits molding of nylon without stringing and with-

out nozzle change. Positive nozzle shutoff also permits full pressure prepacking of the injection cylinder, simultaneous with the cooling cycle. The injection plunger can be retracted before gates are fully set up.

Automatic cycle of this Model 701 takes 3.5 seconds from the time the mold opens until it starts to fill again. One operator can handle as many as 10 of the machines. He needs only to load powder into the hopper and remove the finished pieces in bulk.

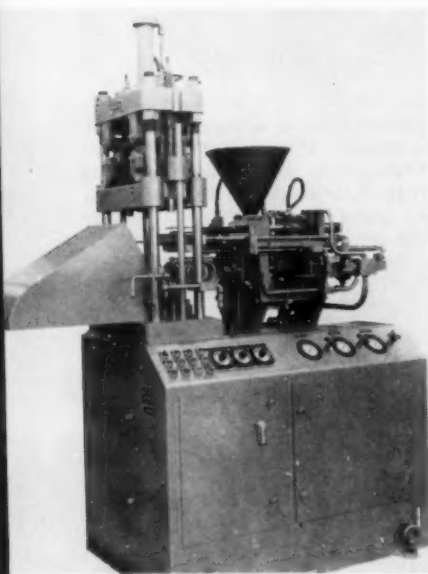
Plastics Div., F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa. **T-8-1692**

Notching Tool

This bench type hand metal notcher, the Whitney-Jensen No. 100, has the capacity to cut a 90-deg notch $4\frac{1}{4}$ in. deep in 16-ga mild steel.

Blade of the unit is operated by a hand lever and eccentric-pivoted link which deliver cutting power to the blade which is 6 in. long on each side, through a V-ram that has adjustable ways to insure positive blade and die alignment. Design minimizes friction. The lower die is quickly and easily adjusted when necessary.

The tool will do various cut-out or



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New SLIDE GUIDE

With this new and different slide rule type comparison chart you can check 21 essential specifications of 8 leading heavy duty milling machines. Compare their capacity, speeds, feeds, etc., at a glance.

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Lepel

HIGH FREQUENCY Induction HEATING UNITS

The Lepel line of induction heating units represents the most advanced thought in the field of electronics as well as the most practical and efficient source of heat yet developed for industrial heating. With a background of half a century of electrical and metallurgical experience, the name Lepel has become the symbol for quality in induction heating equipment embodying the highest standards of engineering achievement, dependable low cost operation and safety.

If you are interested in the application of induction heating you are invited to send samples of the work with specifications of the operations to be performed. Our engineers will process these samples and return the completed job with full data and recommendations without any cost or obligation.

TYPICAL INDUCTION HEATING APPLICATIONS



The simultaneous soldering of a group of components within one load coil is an ideal application for induction heating. The assemblies consist of mounting studs and tubes inserted into a machined part together with preformed solder rings. The heating is done so rapidly that there is practically no scaling or discoloration.



A Lepel installation at Federal Telephone and Radio Co. shown soldering transformer terminals. A precision operation made so simple that even unskilled operators can achieve excellent results on a production basis.



**Electronic Tube Generators—1 KW; 2½KW;
5 KW; 10 KW; 20 KW; 30 KW; 50 KW; 75 KW; 100 KW.
Spark Gap Converters 2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.**

WRITE FOR THE NEW LEPEL CATALOG . . . 36 illustrated pages packed with valuable information.

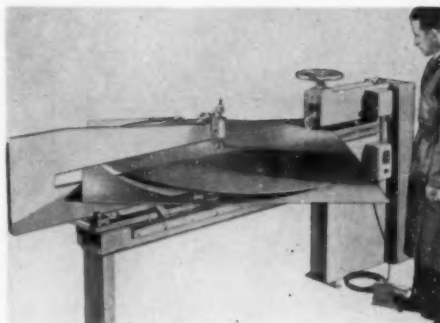


All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

LEPEL HIGH FREQUENCY LABORATORIES, INC.

55th STREET and 37th AVENUE, WOODSIDE 77, NEW YORK CITY, N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-170

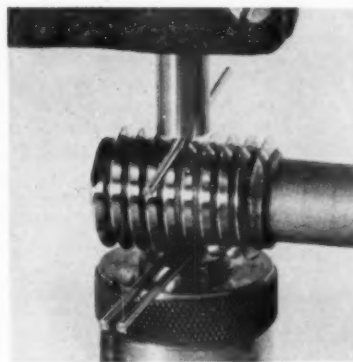


cut-off operations on corners as well as producing 90-deg notches of any depth up to capacity. Guides with 90 and 45-deg sides are fully adjustable close to both cutting edges.

Whitney Metal Tool Co., Rockford, Ill. T-8-1701

Thread Measuring Wires

All thread measuring wires made by Van Keuren for standard 60-deg Unified and American Threads will be calibrated in addition to being furnished



within 0.00002 in. of nominal best size. Individual calibration of each set of wires permits more exact computation of the wire constant. Because of this refinement more accurate pitch diameter measurements may be accomplished.

The Van Keuren Co., 176 Waltham St., Watertown, Boston, Mass. T-8-1702

Bufs

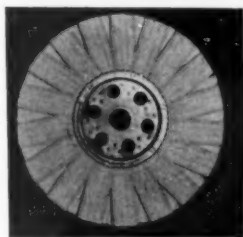
Fast, thorough cutting and coloring of intricate contoured metal surfaces is provided by new lines of cloth and sisal "Sisal-Flex" bufes, and cloth "Tufta-Flex" bufes which can be used in a wide range of heavy and medium metal-finishing processes. Because of their design and materials of construction,

The Tool Engineer

the buffs will cut and color metal in a single operation.

Both types utilize double-folded tufts to provide maximum cutting surfaces and retain compound at leading edges and on the buff circumference. Tufts are staggered in a double row around the buff to prevent streaking, and to provide ventilation and assurance of cool operation.

Cloth and sisal used in these buffs are cut on the bias for strength and long life, while avoiding the problem of loose ends which can scratch or cut



metal surface. A steel center provides strong support for each buff and steel clamps hold the buff in place. Heavy-duty stitching around the buff's inner circumference also adds strength. Six ventilating holes assure free circulation of air from the center of the buff to its periphery. Both Sisal-Flex and Tufta-Flex buffs are available in diameters ranging from 12 to 18 in.

Hanson-Van Winkle-Munning Co., Church St., Matawan, N. J. T-8-1711

Carbide Tool Grinder

Model OCE-6 oscillating carbide tool grinder is adaptable for either conventional grinding or, connected to a power pack, for electrolytic grinding.

With this grinder, the tool is held in stationary position, while the oscillating wheel does the work, assuring uniformly flat grinding. This results in long life for the diamond wheel as the face is being uniformly worn and frequent dressings are not required.

Spindle is constructed for heavy-duty, and the entire spindle assembly, which is dynamically balanced, oscillates on a tapered roller bearing rocker, resistant to end and radial thrust.

Both wheel oscillation per minute and length of stroke are controlled by handwheels located on the front of the machine. Oscillations can be adjusted between 0 to 70 per minute; length of stroke, or amplitude, can be varied to accommodate tools from 1/4 to 2-inch face, using a 3/4-inch face diamond wheel.

V-belt drive is from 1-hp motor. Self-contained unit, accommodating either



SYNTRON

PARTS FEEDERS

Provide Automatic Feeding and Orientation of Small Parts



May be set up in single or multiple units.

In machine operations, testing and sorting processes as well as for assembly, SYNTRON Vibrating Parts Feeders reduce handling costs and increase production. Parts are fed single file—in oriented position—or may be deposited by gravity fed track to dies, indexing tables, etc.—at exactly the right speed. Electro-magnetic operation—no mechanical, wearing parts—no installation problem.

Write for catalog data—FREE!

SYNTRON COMPANY

340 Lexington Ave.

Homer City, Pa.

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OFFSET BORING HEAD

repeats to

.0001"

in 30 seconds

DEKA-BORE (and only DEKA-BORE) can be adjusted in fractions of 1/10,000" on the full diameter as easily as reading 1/16" on a steel rule. NOT A VERNIER OR SCROLL ADJUSTMENT. Can be calibrated in increments of .00005 on radii or .0001 on diameter as easily as picking up .002 on a conventional micrometer dial.

100% GUARANTEED!

PRECISION TOOL & MFG. CO. OF ILL.

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Gentlemen: Please send me

☐ Name of nearest DEKA-BORE distributor, who will arrange free demonstration.

☐ Free literature and prices.

NAME _____ TITLE _____

FIRM _____

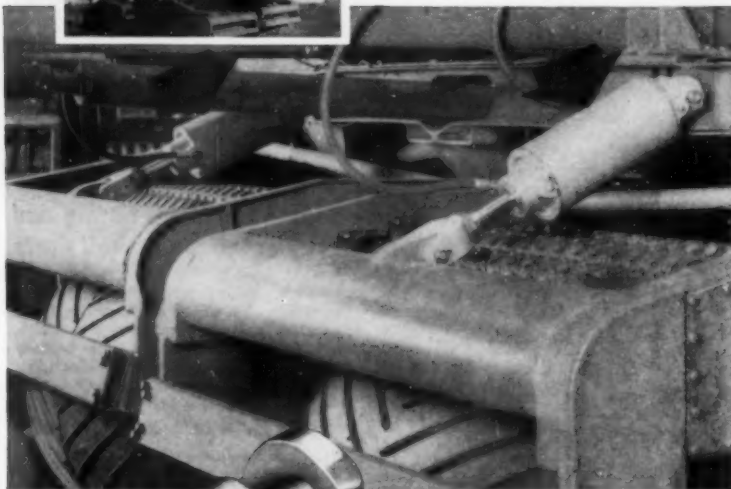
ADDRESS _____

CITY _____ ZONE _____ STATE _____

mail coupon now for free demonstration or literature!

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Arctic Cargo Carrier Depends on T-J Spacemaker CYLINDERS



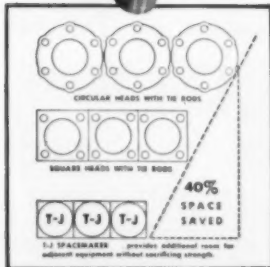
**ALL MODELS...
OFF SHELF
DELIVERY**

**Saves 40% Space
No Tie Rods...
Greater Strength**

Differential axle loading through T-J Spacemaker Air Cylinders forms a controlled walking beam in this Tera-cruiser, designed and produced for the Army Ordnance Corps by the Four Wheel Drive Co., Clintonville, Wis.

Weight of cylinders was important factor in choosing T-J Spacemakers, which reduce weight while providing same displacement and extra high safety factor. Fast delivery and space-saving features also favored T-J. Exclusive with T-J are new Super Cushion Flexible Seals for Air (to 200 P.S.I.)... and New Self-Aligning Master Cushion for Oil (to 750 P.S.I.). Hard chrome plated bodies and piston rods are standard, at no extra cost. Wide range of styles, capacities... 64,000 combinations *off the shelf!* Write for bulletin SM-155-3. The Tomkins-Johnson Co., Jackson, Mich.

MEETS WITH ALL JIC RECOMMENDATIONS



T-J TOMKINS-JOHNSON
DIVISIONS: AIR AND HYDRAULIC CYLINDERS, COILERS, SLIDING



conventional coolant or electrolytic solution, is mounted inside the base. Outlets in hood provide for complete mist removal when connected to a Hammond MistKollector.

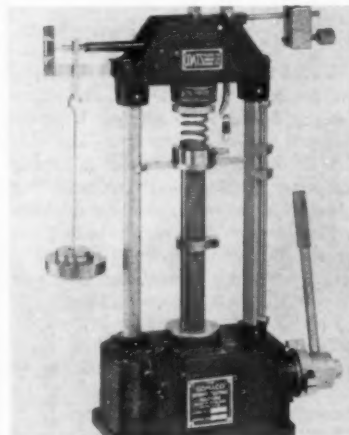
Hammond Machinery Builders, Inc.,
1661 Douglas Ave., Kalamazoo, Mich.
T-8-1721

USE READER SERVICE CARD ON PAGE
165 TO REQUEST ADDITIONAL TOOLS
OF TODAY INFORMATION

Spring Tester

High quantity production testing of loads and deflections of compression and extension springs can be accomplished with this precision unit at speeds up to 800 tests per hour.

Capacity of the tester includes loads from 1/4 oz to 200 lb, spring lengths



to 10 in. and diameters to 2 3/8 in. Guaranteed accuracy is within 1/4 percent.

Automatic production stops and tolerance markers are easily adjustable. Dial indicator and brackets to read deflections to 0.001 in. are available for extreme accuracy.

The Carlson Co., 277 Broadway, New York 7, N. Y.
T-8-1722

FIELD notes

name changes

To better reflect the company's greater emphasis on specialty metals department and manufacture, the name of Carboloy Dept. has been dropped in favor of Metallurgical Products Dept. of General Electric Co. Present major products of the department are cemented carbides and permanent magnets while current plans call for a doubling of both businesses during the next 10 years. Earlier this year, the Detroit laboratory introduced commercially cemented oxide cutting tools, and in May it was revealed that the Detroit plant is successfully operating a pilot facility to make man-made diamonds.

▽ ▽ ▽

Detroit Broach Co., Inc. has changed its name to **Detroit Broach & Machine Co.** According to Gustav von Ries, president, the new identification is more indicative of the company's present activities because it has become a major factor in the design and manufacture of broaching machines.

▽ ▽ ▽

Name of F. J. Stokes Machine Co. was changed as of July 1 to **F. J. Stokes Corp.** The new identification was considered by the company's stockholders to be more in keeping with the broad range of interests and varied line of production and processing equipment which the firm has developed during its 60 years of growth.

new facilities

Site for a \$1½-million plant has been purchased by **Aluminum Co. of America** for future expansion of die casting operations. Location is in Edison Township, N. J. A condition of the sale was that the company start construction within a year and have the new plant in operation in three years. The proposed plant will provide approximately 200,000 sq ft of space and will provide employment for about 750 persons at the start.

The new \$5-million plant, which has been under construction since early 1955, has been completed for the Industrial Heating Dept. of General Electric Co. The facility, located in Shelbyville, Ind., is producing about 50 types of industrial heat processing equipments, heater components and devices.

Prime feature of the plant is a floor level conveyor system designed to ac-

commodate furnaces weighing up to 60 tons. Consisting of steel flat cars drawn by underground drag chains, the system makes possible assembly line production techniques on custom-designed furnaces. Cars can be coupled in multiples to provide a moving platform for complete assembly of almost any size furnace so that it can be drawn through welding, bricking, assembly and painting and other process areas.

The plant also includes a research laboratory devoted exclusively to product research, testing and metallurgical analysis.

▽ ▽ ▽

Ground has been broken for an integrated aluminum mill for **The American Brass Co.** near Terre Haute, Ind. The plant, which will cost more than \$25-million, will cover more than 500,000 sq ft of space and will house an office and research laboratory in addi-

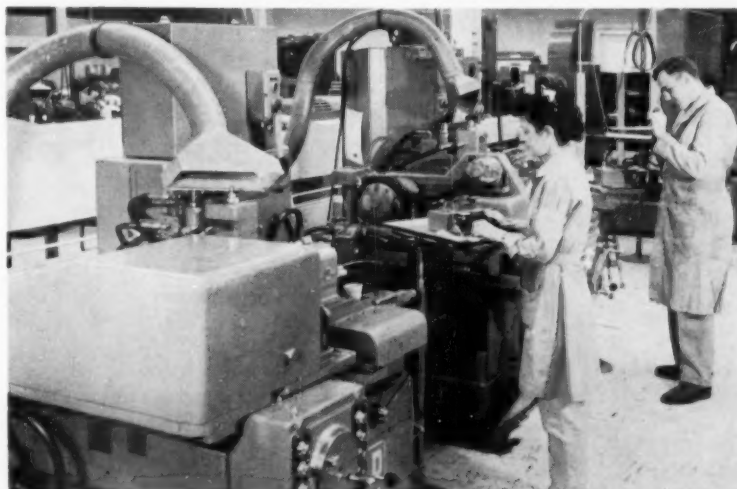
With completion of the \$¾-million **Precision Park plant** at Keene, N.H. for **Miniature Precision Bearings, Inc.** came opening of a facility in the United States specifically designed and built exclusively for production of precision ball bearings in the miniature range of up to ⅜ in. OD. The new plant will enable the company to increase its production capacity (which in 1955 was more than 1,000,000 bearings) by 50 percent while providing space for a still further 50-percent increase. In addition, it affords extensive research and development facilities.

Construction of the installation carried out MPB's management philosophy

of group planning with decentralization of responsibility and authority. Department supervisors participated in planning and layout of their areas. Management groups representing every department then reviewed the plans.

A master control governs temperature and humidity in all production areas except the super critical assembly, inspection and packaging rooms. In the especially critical "white areas" positive air pressure suppresses dust and all air is specially filtered to remove any particle greater than one-millionth inch in size. Employees wear special lint-free clothing and automatic equipment cleans their shoes before entering.

These automatic machines grind the grooves on outer rings of miniature flanged bearings at the new MPB plant. Operator at left is gaging groove depth on an instrument designed by the firm's gage development section.



tion to the mill. It is expected to be in production by the third quarter of 1957 and will eventually require a working force of about 1,000 persons.

✓ ✓ ✓

Construction of a multi-million-dollar plant at Parkersburg, W. Va., will increase the capacity of The Carborundum Co. for production of zirconium to more than 1½-million pounds per year. Zirconium is used in atomic reactors.

✓ ✓ ✓

Square D Co. will construct an electrical equipment assembly plant in Atlanta, Ga. as the base of extended operations in southeast United States. As the expansion program develops, the company's field engineering offices in Georgia, Florida, Alabama and other area states also are expected to be in-

creased. The new plant, involving an investment of \$500,000, is designed to permit future additions.

agreements

Detrex Corp. has entered into an agreement to manufacture and merchandise all package-type conveyors plus other items owned and previously manufactured by B & G Machinery Co. of Indianapolis. Detrex, which also recently announced agreement to purchase all outstanding stock in Hooker-Detrex, Inc., is shortly to be known as Detrex Chemical Industries, Inc.

✓ ✓ ✓

In a joint statement made by Joseph T. Ryerson & Son, Inc. and Reynolds Metals Co. it was announced that Ryerson would sell Reynolds aluminum

throughout the areas presently served by its Chicago and Milwaukee plants. Ryerson initially will sell aluminum in pattern and cut-to-size sheets, coils, rods, bars and plates in a broad range of types and sizes.

✓ ✓ ✓

Under a patent licensing agreement, Seibert and Sons, Inc. are manufacturing a tool control system commonly called tool boards. The unit includes tool holding board, bench, cyclometers, adjustable adapters, gages and fixtures individually tailored to specific machine application.

purchase

Agreement has been reached by Greenfield Tap and Die Corp. to purchase all assets of Horton Chuck Div. of E. Horton & Son Co. For the present manufacturing operations will continue in Windsor Locks and no immediate changes in sales policies are expected. D. H. Thomson continues as general manager of the Chuck Div. and G. S. Chiaramonte as sales manager.

new companies

A newly organized firm of Fastcut Tool Co. has been established at 7405 E. Davison, Detroit 12, Mich. The company, headed by Earl W. Bathey as president, is manufacturing the line of Fastcut cutting tools, formerly products of the Fastcut Div. of Hilton Mfg. Co.

✓ ✓ ✓

Formation of Tyron, Inc. has been announced by the company's president, Harold S. Mickley. The firm was organized to undertake industrial research, development and manufacture in the fields of mechanical and chemical processes.

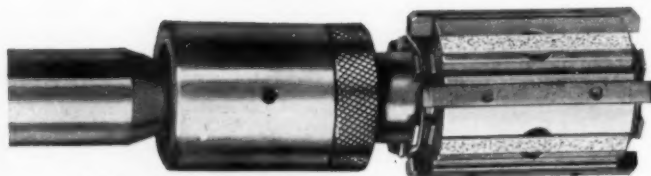
expansions

Work has been scheduled for construction of a modern factory for the Speed-D-Burr Corp. near Lomita and South Main in Los Angeles, Calif. The new plant, which will cost over \$250,000 will more than triple present manufacturing facilities of the company.

✓ ✓ ✓

Crucible Steel Co. of America and its affiliate, Rem-Cru Titanium, Inc. have announced a joint \$400,000 improvement program for increasing titanium processing facilities at Crucible's

BARNESDRIL HONING TOOLS and ABRASIVES



check these features

✓ BODY SUPPORT

—freer cutting action due to support of stone close to cutting edge. Less spalling.

✓ GREATER STONE LIFE

—more usable abrasive with Plas-T-Clad Stone design. Reduced downtime for replacement.

✓ ELECTRONIC FEED

—automatic compensation for stone wear, and maintains proper pressure between stone and work at all times.

GET COMPLETE DATA IN CATALOG 500A



BARNES DRILL CO.

870 CHESTNUT STREET • ROCKFORD, ILLINOIS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-174

Park Works in Pittsburgh. These new improvements are expected to double capacity of the Works for rolling of titanium sheet. The program includes installation of a continuous double row furnace for heating titanium slabs, erection of a building to house a bar yard and auxiliary titanium processing equipment, and the remodeling of a sheet mill. The improved facilities will be used for titanium processing exclusively.

✓ ✓ ✓

The Lincoln Electric Co. has announced an \$8-million expansion of its plant capacity for manufacturing arc welding machines and electrodes. Work has started to complete \$2-million of this expansion by the end of 1956. Manufacturing capacity will be enlarged by 60 percent.

MOVES

Alloy Precision Castings Co. has leased a new plant covering 23,000 sq ft at 3855 W. 150th St., Cleveland, Ohio. Operations in the new plant began July 15, and all production facilities from the company's factories at East 45th and Hamilton Aves. and 13721 Bennington Ave. in Cleveland are being moved to the new location.

✓ ✓ ✓

New home for the Sterling Die Div. of Pratt & Whitney Co. Inc. will be located in Southwest Industrial Park, Cleveland, Ohio. Scheduled for occupancy October 1, it will house the division's expanded manufacturing operations and administrative offices.

new offices

The Lima Electric Motor Co. has opened a branch office at 6432 Cass Ave., Detroit, Mich. to handle electric motor and gearshift drive sales for the firm in the Detroit area. Replacement market in the area will continue to be serviced by authorized Lima dealers headed by Robert F. Brown Machinery.

✓ ✓ ✓

Crucible Steel Co. of America recently officially opened its new sales office and warehouse building at 7901 Sovereign Row in the Brook Hollow industrial district of Dallas, Texas.

✓ ✓ ✓

District sales and service office has been opened in Winnipeg by Gardner-Denver Co. (Canada), Ltd. to serve throughout Manitoba, western Ontario and eastern Saskatchewan. District manager in the area is J. A. Caverly.

August 1956

DO IT BETTER — QUICKER — AT LESS COST

WITH **Atrax** SOLID CARBIDE

STANDARDS!

*Atrax stock tools
eliminate the waste & worry
of "specials" 99 times
out of 100!*

All of the standards in the Atrax line were once "specials"—engineered and built to meet specific production demands. When the Atrax requirements of performance and dependability were proved, these tools were stocked as standards at standard prices—and are now available without delay, to meet virtually all metalworking needs. Whenever you're faced with a tough job, consult the Atrax catalog listing over 1000 standard tools before you order a "special". A production-proved tool to do the job—and do it right—is undoubtedly in stock. Always specify Atrax, you can't get a better tool—you can't get better performance.

*Eliminate the cost and delay of "specials"
—send today for the Atrax catalog illustrating more than 1000 solid carbide tools to do 99% of all metalworking jobs!*

Atrax



THE ATRAX COMPANY
Newington 11, Conn.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-175

TRADE literature

For Free Booklets and Catalogs—Convenient Request Card on Page 165

Marking

Seventy-two page, spiral bound pictorial brochure presents story on how manufacturers in various fields are using equipment to advantage for marking applications; also outlines examples of installations at customers' facilities to solve various cost or production problems. Geo. T. Schmidt, Inc., 4100 Ravenswood Ave., Chicago 13, Ill. **L-8-1**

Tool Holders and Boring Tools

Brochure discusses Flash-Change tool holders and companion boring tools for quick change tooling emphasizing important advantages and special features; covers design, construction and operation and applications; includes dimensional drawings, and specification lists. DeVlieg Microbore Co., 2720 W. Fourteen Mile Rd., Royal Oak, Mich. **L-8-2**

Thread Grinder

Detailed data concerning construction, grinding methods, applications and specifications for centerless thread grinding equipment presented in well illustrated 10-page Bulletin E-97-1 which also points out features and advantages of the line. Landis Machine Co., Wayneboro, Pa. **L-8-3**

Cast Iron

Four-page leaflet, "Summary of Cast Iron Specifications," covers commonly used specifications of gray and nodular cast irons; included in list of principal specifying bodies are ASA, ASME, ASTM, SAE, American Water Works Assn., Canadian Standards Assn., Federal and U. S. Military Services, Gray Iron Founders' Society, Inc., 930 National City-East Sixth Bldg., Cleveland 14, Ohio **L-8-4**

Underdrive Presses

Illustrated 32-page catalog shows line of single, double and triple action underdrive presses ranging in capacity from 400 to 2000 tons; includes closeup and detailed views of special design and construction features, complete dimension and specification lists plus easy-to-read charts; also illustrates and describes various press, accessories. Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago, Ill. **L-8-5**

Tubing

Reissued 12-page catalog covers cold drawn mechanical, capillary, hypodermic, nickel and nickel alloy tubing; describes company's line as well as tubular fabricated parts made in its specialties plant; includes data such as comparative analysis of alloy types, specifications, standard tolerances, physical properties and relative workability. M. A. Hatch, Stainless Steel Products Div., J. Bishop & Co. Platinum Works, Malvern, Pa. **L-8-6**

Steel Strapping

Extensively illustrated 44-page steel strapping catalog offers constructive suggestions to speed packaging, lower handling costs and assure safe shipment; 5 basic ways to use steel strapping described plus description of steel strapping tools and equipment. Acme Steel Products Div., Acme Steel Co., 2840 Archer Ave., Chicago 8, Ill. **L-8-7**

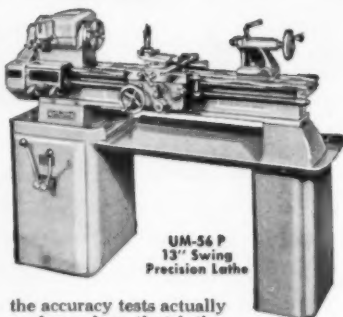
SHELDON Precision LATHES

for the size Lathes You Need Most

Sheldon lathes are built in the sizes you need most, for toolroom and production jobs. They are available with swings of 10", 11" and 13" . . . in varying bed lengths with 18" to 48" center distances . . . and . . . in your choice of pedestal, cabinet or bench mountings.

Powerful, all-V-belt, drive units—either the standard 8-speed (or 16-speed) E-drive; or the production favorite, a rapid, lever-shift U-drive. Where higher spindle speeds are desired, the standard E-drive can be built to provide speeds up to 2,000 r.p.m.

All Sheldon Lathes have hand-scraped, built-in precision. Each lathe is guaranteed to meet or surpass the American Standards for Toolroom Accuracy. With every Sheldon Lathe goes a copy of

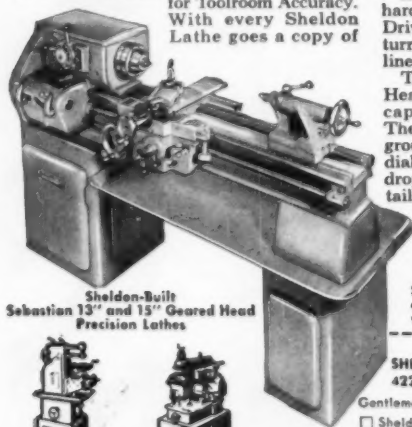


the accuracy tests actually performed on that lathe. (19 checks).

Important optional features include: hardened bed ways, L00 Long Taper Key Drive spindles, 4" DI Camlock spindles, bed turrets, taper attachments and a complete line of toolroom and production accessories.

The new Sheldon-built Sebastian Geared Head Lathes have greatly increased work capacity and many advanced features. These include a wide, heavy, hardened and ground bed . . . easy shifting spindle speed dial . . . 60-pitch gear box . . . independent drop lever apron clutches . . . cam-action tailstock clamp . . . and, automatic lubrication in the headstock and apron with "1-shot" lubrication of carriage.

Send in coupon or write for catalogs and names of nearest Sheldon and Sebastian Distributors where you can see these new lathes in operation.



Sheldon-Built Sebastian 13" and 15" Geared Head Precision Lathes



SHELDON Horizontal Milling Machine



SHELDON 12" Shaper

SHELDON MACHINE CO., Inc.

Builders of Sheldon Lathes, Milling Machines, Shapers and Sebastian Lathes.

4229 North Knox Ave • Chicago 41, Ill.

SHELDON MACHINE CO., INC.
4229 North Knox Avenue, Chicago 41, Illinois

Gentlemen: Please send new catalogs describing:

- ☐ Sheldon 10", 11" or 13" Lathes
☐ Sebastian 13" and 15" Geared Head Lathes
☐ Horizontal Milling Machine ☐ Name of Local Dealer
☐ Sheldon 12" Shaper ☐ Have representative call.

Name _____ Title _____

Company Name _____

Street Address _____ ☐ Company ☐ Home

City _____ State _____

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-8-176

Flexible Tubing

Bulletin 61 describes and illustrates the cost saving features of hand bendable tubing emphasizing its installation advantages; includes prices and specification. The Flexaust Co., 100 Park Ave., New York 17, N. Y.

L-8-8

Materials Handling Equipment

Condensed catalog No. 564 contains 50 pages of pertinent technical data plus descriptions and photos of vibratory materials handling equipment as well as other industrial equipment made by the company. Syntro Co., 340 Lexington Ave., Homer City, Pa.

L-8-9

Cutting Tools

Hardware catalog presents details on company's drills, drill sets, drill assortments, reamers and countersinks made of high-speed, carbon steel and carbide for use in steel, wood, masonry and glass. Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.

L-8-10

Roller Chain

Information on complete line of roller chain presented in 148-page Book 2457; includes sections on stock drives, installation and maintenance, lubrication, conveyor chains, casings and other pertinent subjects; well illustrated, includes necessary information for choosing right roller chain for given application. Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.

L-8-11

Switches

Sixteen-page booklet, "Micro Tips Digest," contains 43 illustrated descriptions of uses for snap-action switches in a wide variety of industrial and commercial uses, to improve safety, lower costs, increase production and make electrically operated equipment more automatic. Micro Switch, Freeport, Ill.

L-8-12

Bronze Bearings

"Stook List S-56" gives dimensions of line of 1050 sleeve, flange and thrust Oilite bronze bearings, in sizes ranging from $\frac{1}{8}$ to 4 in. ID; also includes information on selection of cored, bar and plate stook plus 6 pages of pertinent engineering data. Amplex Div., Chrysler Corp., Detroit 32, Mich.

L-8-13

Single Spindle Automatics

All of the various sizes and models in the Cleveland line of single spindle automatics described in illustrated brochure; includes disoussion of special features, uses and specifications. The Cleveland Automatic Machine Co., Cincinnati 12, Ohio.

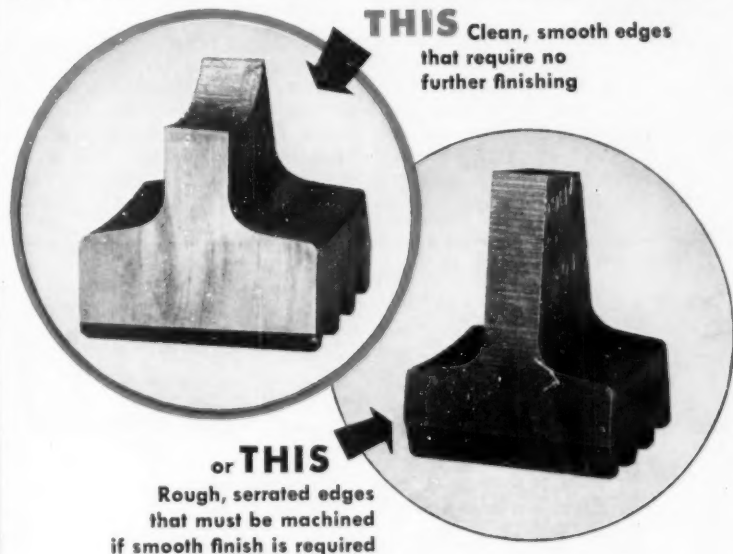
L-8-14

Abrasive Cutting

the best way to cut many materials
the only way to cut some

Campbell Cut-Off Machines

WHAT KIND OF A CUT DOES YOUR JOB REQUIRE?



* The smooth cut—made on a CAMPBELL Oscillating Wet Abrasive Cut-Off Machine and the just-right ALLISON Abrasive Wheel for the job—saves a grinding operation at a Midwest gear plant.

Another combination of CAMPBELL Cut-Off Machine and ALLISON Wheel cuts stainless steel tube twice as fast as by other methods for a large aircraft manufacturer.

Can you cut tough K Monel, $4\frac{1}{4}$ " dia., in two minutes per cut by present methods? Whatever your problem, our abrasive cutting specialists can improve your cutting operation and save you money.

OSCILLATION makes these big cuts with speed and economy

* The cross section of gear teeth (shown left above) is cut smooth, fine-finished and ready for metallurgical study.

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Bar Automatic

Sixteen-page brochure describes and illustrates fine points of company's single spindle bar automatic called Screw-matic 750; includes details of construction, main operation features, and advantages of design. The Gear Grinding Machine Co., 3901 Christopher, Detroit 11, Mich. **L-8-15**

Turret Lathes

Extensively illustrated brochure presents details of Masterline ram type universal turret lathes; includes discussions of important features and advantages, pictures and descriptions of accessories, lists of specifications. Gisholt Machine Co., Madison 10, Wis. **L-8-16**

Metalworking Machines

Complete line of Di-Acro metalworking machines presented in 44-page catalog; extensively illustrated to show features, applications and advantages of equipment; includes specification lists and cost information. O'Neil-Irwin Mfg. Co., 625 Eighth Ave., Lake City, Minn. **L-8-17**

Industrial Trucks

Fiftieth anniversary of industrial truck production is marked by publication of 4-page illustrated brochure describing company's 6 new lines of trucks Elwell-Parker; also highlights basic truck attachments. The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio. **L-8-18**

Welding

Pocket-size 170-page Welding Data Book, T IS 2575, outlines simplified welding procedures for all base metals; useful as guide to torch and metallic arc welding, brazing and soldering; offers "how-to-weld" information on fabrication, maintenance repair, salvage, overlaying for wear and corrosion resistance and welding of dirty, rusted parts; also gives data on methods of gouging, chamfering and removing unwanted metal without special equipment; illustrated. Technical Information Service, Eutectic Welding Alloys Corp., 40-40 172nd St., Flushing 58, N. Y. **L-8-19**

Index Tables, Transfer Units

Catalog 301 offers 24 pages of information on more than 150 standard high-speed Intermittent index tables and points out special features and advantages; also describes standard power assemblies, stands and control panels which may be ordered from stock to form complete rotary transfer machine for automatic assembly. Ferguson Machine & Tool Co., P. O. Box 5841, St. Louis 21, Mo. **L-8-20**

Nickel Tubing

Handbook information on nickel and nickel alloys for use by designers, production engineers and purchasing executives presented in illustrated 20-page catalog, "Superior Tube Nickel and Nickel Alloy Tubing;" includes mechanical and chemical properties as well as a guide to selection and application of various alloys. Superior Tube Co., 1732 Germantown Ave., Norristown, Pa. **L-8-21**

Toolholders and Carbide Inserts

Complete line of toolholders and carbide inserts presented in 24-page catalog No. VR-437; describes both positive and negative rake toolholders utilizing throw-away inserts and negative rake toolholders using standard inserts up to 1½ in. long; illustrates various styles, gives physical dimensions, prices and ordering information for toolholders and square, triangular and round carbide inserts; also gives recommendations covering carbide grades to use for various machining operations. Vascoloy-Ramet Corp., Waukegan, Ill. **L-8-22**

Limit Switch

Service Bulletin 1600B describes and illustrates rotary cam limit switch for mechanical presses; giving details of its design, construction, wiring, installation and applications. Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill. **L-8-23**



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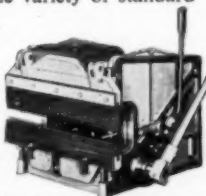
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INDICATE A-8-179-1

August 1956

abstracts of FOREIGN LITERATURE

By M. Kronenberg
Consulting Engineer

Shortening Tool Life Tests

If a method could be found that would permit testing tools and cutting fluids in a few minutes' time, it would have great significance. Many suggestions which have been advanced and the reasons for their failure are discussed in an article by M. E. Mueller and W. Kirchsieper published in the April 1956 issue of *Werkstattstechnik und Maschinenbau*. The authors divide short-cut tool life tests into three categories; namely, tests with steadily increasing cutting speed, tests with rigorous cutting conditions and radioactive tests.

The method of steadily increasing cutting speeds is applicable only in the case of high-speed steel tools due to the fact that it depends on the resultant burnishing of the workpiece at the instant of tool failure. Burnishing is usually absent at the instant of failure of carbide tools. The second method uses high cutting speeds in order to obtain failure after a short time of cutting. This method requires an extrapolation of plotted curves for the tool life cutting speed relationship and for this reason the results are unreliable. Radioactive test results, showing the wear of the tool, are obtained in a few seconds. The authors indicate, however, that wear during the first few seconds is not a reliable indicator.

The authors have made studies of the progress of wear with time and come to the conclusion that three periods exist. During the first period the tool wear increases rapidly, flattening out after a certain time; during the second period the wear increases proportional to time; and during the third period the wear increases at an accelerated rate with time. Excluding the third period, which should not be considered in tool life tests for practical reasons, the authors maintain that the second period of wear is highly important and gives an indication of the true tool life. The authors have developed formulas to correlate the first and second period of wear and conclude that short-cut tests are not



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179

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180

feasible at present. They suggest including a time factor in the standard value for tool wear. In USA this value is 0.040 in. The time limit, which should be added for making short-cut tool life tests practical ought to be investigated.

Determining Tracer Controlled Machining Time

An interesting and thorough study authored by G. Kupka of determination of machining time for tracer controlled turning operations appeared in Issue No. 4, 1956 of *Werkstattstechnik und Maschinenbau*. He differentiates between three different types of copying methods: the 90-deg method, the 180-deg method and the contact method. In the first method machining 90-deg angles is possible from one side only, while 60-deg cones can be produced from either side. In the second method machining 90-deg angles is possible for inbound and outbound turning 180 deg. While these two methods work steadily, that is without steps, the third method is based on the formation of such steps, although they may be small.

The tracers can be so arranged that either the longitudinal or the cross feed is in operation or so that the longitudinal feed is engaged while the cross feed is interrupted as the contour requires or, as a third possibility, so that the cross feed is engaged while the longitudinal feed is interrupted.

Based on these conditions, the author develops formulas for the machining time for longitudinal turning and cross feed turning for 90-deg and 180-deg methods also for the contact method.

Testing Surface Finish

W. Leyensetter reports in the April 1956 issue of *Werkstatt und Betrieb* an investigation of surface finish measuring methods, comparing various instruments such as the Talysurf tester, the Leitz-Forster tester, the Johansson instrument, the Schmaltz surface tester and the Zeiss-Linnik microscope.

He has also made numerous tests with a film contact method and reports that under certain conditions an untrue waviness may be indicated. If it is desired to check the finish of surfaces of great curvature by means of the film contact procedure, it is advisable to leave the film on the work only for a short while. Contact films take on the shape of the workpiece and it may be difficult to straighten them and place them on a glass plate as required for tracing the film surface when measuring the finish. However, when these precautions are taken into consideration, no great troubles will be encountered with the film contact method. The author lists a number of advantages, among them the possibility of measuring curved surfaces such as tooth contours

The Tool Engineer

without complicated instrumentation and also the ease with which less accessible workpieces can be tested.

Reproductions of surface finishes obtained in various machining operations are included.

Electro-erosive Metal-cutting in Russia

A survey of the development of the electro-erosive metal-cutting methods in the Soviet Union is given in the Swiss magazine *Technica*, May 11, 1956 issue. Three different types are mentioned; namely, the electrocontact method, the anode-mechanical system and the spark machining procedure. In the first case metal removal is accomplished by an electric arc between the microscopic peaks on tool and work; in the second case d-c current is used in conjunction with chemicals, removing metal by a combination of chemical and thermal reactions. The article concludes with the third case where the high temperature of the spark is responsible for metal removal. Data are reported on numbers of machines built in Russia since 1950, features and accuracies.

Punching Holes

Investigation of metal flow and friction in punching of holes, discussed in the July 1956 issue of *THE TOOL ENGINEER* in this column, has been continued by R. Dies. New information is furnished in an article on forces, wear and friction in piercing sheet metal with round punches. This article was published in Issue No. 4 of *Werkstatt und Betrieb*.

The author indicates that breakage of punches is more likely to occur during the return stroke than during the down stroke. For this reason he investigated the relationship of the forces for the two directions of motion. He attached strain gages to a converted 60-ton press for measuring the forces. He found that return forces may be as high as 40 percent of the cutting forces, although it has been common assumption that the return force may be up to only 10 percent of the downward force.

Pressure Distribution in Radial Ball Bearings

Further research on the load distribution in radial ball bearings has been carried out by E. Meldau, who presented his first finding about two years ago (see *THE TOOL ENGINEER*, May 1954, page 164). In his article published in *Werkstatt und Betrieb* of April 1956 he gives a more generalized treatise of the subject than before.

This new article discusses simultaneous displacement and rotation and is of particular significance in designs where a single radial ball bearing is used.

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Mechanical Goods Division

United States Rubber



New president of National Fluid Power Association is **J. J. Pippenger**, vice-president of Double A Products Co. Mr. Pippenger also is a member of ASTE's Ann Arbor Area chapter. Other officers elected at the association's annual meeting were **R. J. Murphy** of The New York Air Brake Co., first vice-president; **J. A. Marsh** of Rivett Lathe & Grinder, Inc., second vice-president; and **Ellwood G. Peterson** of Hannifin Corp., treasurer.

Recent promotions at Bay State Abrasive Products Co. included **Harold G. Clayton** who was made vice-president in charge of manufacturing, and **Elden L. Auker** who became vice-president in charge of sales. Mr. Clayton previously served as factory manager. Mr. Auker, who is a member of ASTE's Worcester chapter, was previously sales manager of the company.

G. A. Goepfrich is now vice-president of engineering and **D. M. Stevenson** vice-president of sales at The Skinner Chuck Co. Mr. Goepfrich, who also is a member of ASTE's Hartford chapter, was formerly chief engineer of the company. Mr. Stevenson previously was midwestern sales manager.

Earl C. Hughes has been elevated from vice-president to executive vice-president of Bay State Abrasive Products Co. Mr. Hughes, who has been with Bay State since 1936, is also secretary and corporation clerk.

William J. Loach, executive vice-president and co-founder of Firth-Loach Metals, Inc. has been elected to serve as president of the firm. Mr. Loach has been active in the powder metallurgy field since 1928.

Several new officers were elected during the recent meeting of stockholders and directors of Onsrud Machine Works, Inc. Among them were **Albert L. Breuer**, who was made vice-president in charge of machine tools sales; **Robert M. Miller**, who became vice-president in charge of woodworking machinery sales; and **Earl Pankonin**, who was elected vice-president in charge of engineering.

In addition, **G. M. Campbell** was advanced from vice-president and secretary to executive vice-president.

Jack R. DeBacher has been elected a full vice-president of Thor Power Tool Co. Prior to this he was executive vice-president of the Thor Speedway Mfg. Div. His new activities will encompass the company's business of centralization of all Thor manufacturing, sales and engineering divisions.

Officers elected at the recent meeting of American Gear Manufacturers Assn. to serve with new president Gunnar Gunderson were **LeRoy R. Brooks** as vice-president and **Thomas A. Jones** as treasurer. Mr. Brooks is president of Tool Steel Gear & Pinion Co., and Mr. Jones is general manager of the Jones Machinery Div., The Hewitt-Robins, Inc.

Gunnar E. Gunderson was elected president of the American Gear Manufacturers Assn. at the organization's recent annual meeting. Mr. Gunderson has been president of the Brad Foote Gear Works, Inc. since 1950.

Charles M. Reese and **A. H. Dall** have been made vice-presidents of Cincinnati Milling and Grinding Machines, Inc., sales subsidiary of The Cincinnati Milling Machine Co. Mr. Reese, advertising manager, has been associated with Cincinnati Milling Machine since 1923 when he became a cooperative student in the Engineering College of the University of Cincinnati while doing his cooperative work at the company. Mr. Dall, director of standard machine tool engineering and development, also joined Cincinnati Milling as a student in the University of Cincinnati Cooperative Engineering College, doing his coop work as a draftsman and machine designer starting in 1925.

Glenn E. Seidel has been named to the recently created corporate position of vice-president in charge of engineering for Minneapolis-Honeywell Regulator Co. A member of the organization for almost 14 years, he has been vice-president, engineering, since 1952.

Directors of the Osborn Mfg. Co. have elected **R. O. Peterson** to the office of vice-president, Brush Div.-Engineering, to assume increased responsibilities in the company's accelerated program of research and development.

J. Robert Tomlinson, formerly executive vice-president of The Barden Corp., was recently elected president of the company. He succeeds F. E. Ericson who resigned but continues as a consultant to management.



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Appointment of **Karl W. Galliger** to the post of director of Engineering has been made by The New York Air Brake Co. Engineering manager of the company's Watertown Div. since 1953, he now is responsible for research and engineering and for organization policies, procedures and development programs of the engineering departments of all divisions of the company.

Cincinnati Lathe and Tool Co. has announced election of **E. L. Ritter** as vice-president in charge of engineering, and of **David A. Wallace** as vice-president in charge of sales. Mr. Ritter has been associated with the engineering activity of the firm since 1945, while Mr. Wallace formerly was sales manager of the company.

Lawrence L. Garber has been named to fill the newly created position of vice-president in charge of production for H. K. Porter Co., Inc. to supervise production for the company's thirteen divisions. He previously was general manager of the Alloy Metal Wire Div.

At the same time **Eugene Salinger** was appointed general manager of Porter's Henry Disston Div. Mr. Salinger joined Porter earlier this year as assistant general manager of the Riverside Metal Div.

The Wellman Engineering Co. has announced election of **W. L. Komph** and **F. J. Theisen** vice-presidents of its Anker-Holth Div. Mr. Komph is in charge of sales and engineering for the Division. Mr. Theisen, new vice-president-production has been works manager for Anker-Holth since its merger with Wellman in 1951. He is a member of ASTE's Detroit chapter.

Two appointments recently were announced by Jarvis Corp. **Andrew E. Josephson**, who has been associated with the firm since 1937, was made production manager and director of purchasing.

Earlier, **George J. Carvalho**, formerly manufacturing superintendent of the Universal Winding Co., was made general manager of Jarvis Power Tools, Inc., wholly owned subsidiary of Jarvis Corp.

Directors of Tube Reducing Corp. have promoted **Arthur J. Williamson** to the office of executive vice-president. He had been a vice-president of the firm since 1951.

At the same time, the board announced elevation of **Graham B. Brown**, former works manager, to the post of vice-president-operations. **C. L. Megargle**, who had been assistant sales manager, was named general sales manager of the company.

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Who's meeting and where

Aug. 6-8. SOCIETY OF AUTOMOTIVE ENGINEERS, INC. National West Coast meeting. Mark Hopkins Hotel, San Francisco, Calif. More information is available from society office, 29 W. 39th St., New York 18, N. Y.

Aug. 6-17. UNIVERSITY OF CALIFORNIA AT LOS ANGELES, Department of Engineering, cooperating with University Extension and Los Angeles Section of American Society of Quality Control sponsoring a course on Statistical Methods in Industry. Request more details from Prof. Edward P. Coleman, Dept. of Engineering, UCLA, Los Angeles 24, Calif.

Aug. 22-24. AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting of national hydraulics division, University of Wisconsin. Inquire for details from Prof. Arno T. Lenz, College of Engineering, University of Wisconsin, Madison, Wis.

Sept. 7-9. METAL POWDER ASSN. Fall meeting, The Homestead, Hot Springs, Va. Get full particulars from association office, 420 Lexington Ave., New York 17, N. Y.

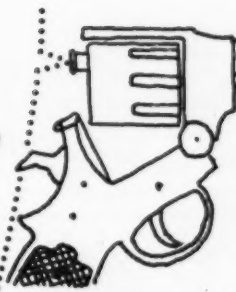
Sept. 9-12. NATIONAL METAL TRADES ASSN. Eastern plant management conference, Essex-Sussex Hotel, Spring Lake, N. J. Association office, 122 S. Michigan Ave., Chicago 3, Ill., can supply other facts.

Sept. 10-15. INVESTMENT CASTING INSTITUTE. Intensive 6-day course, University of Michigan. For more data, write to institute office, 27 E. Monroe St., Chicago 3, Ill.

Sept. 11-13. AMERICAN DIE CASTING INSTITUTE. Annual meeting, Edgewater Beach Hotel, Chicago, Ill. Write for other data to institute office, 366 Madison Ave., New York 17, N. Y.

Sept. 11-14. PACKAGING MACHINERY MANUFACTURERS INSTITUTE. Packaging

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- **Rod Scraper**—cleans piston and protects rod, packing and bearing;
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machinery and materials exposition, Public Auditorium, Cleveland, Ohio. For further information, contact Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

Sept. 16-21. AMERICAN CHEMICAL SOCIETY. Annual meeting, Convention Hall, Atlantic City, N. J. Society office, 1155 16th St. N. W., Washington 6, D. C., will provide further data.

Sept. 16-22. AMERICAN SOCIETY FOR TESTING MATERIALS. 2nd Pacific area national meeting and apparatus exhibit, Hotel Statler, Los Angeles, Calif. Details may be had from society office, 1916 Race St., Philadelphia 3, Pa.

Sept. 17-21. INSTRUMENT SOCIETY OF

AMERICA. 11th annual instrument-automation conference and exhibit, New York Coliseum, New York, N. Y. Direct inquiries to society office, 1319 Allegheny Ave., Pittsburgh, Pa.

Sept. 19-21. PORCELAIN ENAMEL INSTITUTE, INC. 25th annual meeting. The Broadmoor, Colorado Springs, Colo. Institute headquarters, 1145 Nineteenth St., N. W., Washington 6, D. C., can provide other data.

Sept. 21. CUTTING TOOL MANUFACTURERS ASSN. Fall meeting, Lockmoor Club, Detroit, Mich. Write to association office, 416 Penobscot Bldg., Detroit 26, Mich. for details.

Sept. 24-25. MATERIAL HANDLING IN-

STITUTE. Fall meeting, Greenbrier, White Sulphur Springs, W. Va. For more facts write institute office, One Gateway Center, Pittsburgh 22, Pa.

Sept. 24-25. STEEL FOUNDERS' SOCIETY OF AMERICA. Fall meeting, The Greenbrier, White Sulphur Springs, W. Va. Request more information from society office, 606 Terminal Tower, Cleveland 13, Ohio.

Sept. 25-27. ATOMIC INDUSTRIAL FORUM, INC. 2nd annual trade fair of the atomic industry, Navy Pier, Chicago, Ill. Get other facts from organization's office, 260 Madison Ave., New York 16, N. Y.

Sept. 25-28. ASSOCIATION OF IRON AND STEEL ENGINEERS. Annual meeting and exposition, Public Auditorium, Cleveland, Ohio. Write for details to association office, 1010 Empire Bldg., Pittsburgh, Pa.

Oct. 1-3. NATIONAL ELECTRONICS CONFERENCE INC. Annual meeting and exhibit, Sherman Hotel, Chicago, Ill. Details are available from conference headquarters, 84 E. Randolph St., Chicago 1, Ill.

Oct. 1-5. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Fall general meeting, Morrison Hotel, Chicago, Ill. Write for more information to institute office, 33 W. 39th St., New York 18, N. Y.

Oct. 2-6. SOCIETY OF AUTOMOTIVE ENGINEERS INC. National aeronautic meeting, aircraft production forum and aircraft engineering display, Hotel Statler, Los Angeles, Calif. More information may be had from society office, 29 W. 39th St., New York 18, N. Y.

Oct. 3-5. STANDARDS ENGINEERS SOCIETY. Fifth annual meeting on "Standards—Guides for Tomorrow," Hotel Willard, Washington, D. C. Write to the society, P. O. Box 281, Camden 1, N. J. for more information.

Oct. 8-10. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Lubrication conference, Chalfonte-Haddon Hall, Atlantic City, N. J. Society office, 29 W. 39th St., can supply other information.

Oct. 8-12. AMERICAN SOCIETY FOR METALS. National metal congress and exposition, Public Auditorium, Cleveland, O. Obtain further facts from society headquarters, 7301 Euclid Ave., Cleveland 3, O.

Oct. 8-12. AMERICAN WELDING SOCIETY. Fall technical meeting, Hotel Cleveland, Cleveland, O. Write for information to society office, 33 W. 39th St., New York 18, N. Y.



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technical *Shorts*

ACCORDING TO report from the American Welding Society, a method of welding has been developed which utilizes the energy of ultrasonic vibrations. Although still in the realm of experiment, solid state bonding has been achieved both with similar and dissimilar metals by introduction of elastic vibratory energy into the metals in the area to be joined. At present, studies indicate the process is applicable to joining foil and thin sheet to either very thin or massive members.

Ultrasonic Welding Technique

CONVENTIONAL LUBRICATION may be unnecessary in many types of bearings as the result of a recently developed automobile suspension joint. Key to this development is the use of Teflon tetrafluoroethylene fiber woven into fabric. Teflon, considered one of the most slippery materials, can now be used under heavy load. Engineers suggest that use of fabric of this fiber to face metal suspension joints, in addition to functioning without customary lubrication, will reduce the amount of friction by an estimated 50 percent in comparison with standard lubricated suspension joints used in automobiles.

Develop Fiber For Bearing Lubrication

Development of this use for the fiber was carried out by American Metal Products Co. with Du Pont, originator of Teflon, cooperating in the work.

Most of American Metal Products Co.'s efforts to date have been directed toward improved front and rear suspension components for automobiles. Several automobile manufacturers, have such assemblies on test.

Use of Teflon tetrafluoroethylene fiber in a ball-and-socket suspension joint is achieved by double weaving it with a backing of nylon or cotton. This fabric is then laminated with cotton-reinforced phenolic resin and formed into a cup which lines the socket. Metal parts are coated with a special grease to prevent

corrosion. The joint is assembled, the preformed bearing is molded in place and the joint sealed.

Other frictional applications of Teflon fiber which may eliminate need for conventional lubrication also are under development. These include:

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Tests conducted under a compression load of approximately 1000 psi showed that a force of 9.4 lb was required to move the standard joint and 7.0 lb to keep it moving after starting friction was overcome. The same test on a joint lined with fabric of Teflon showed the force required to be 2.1 lb initially, dropping to 1.2 lb. The smaller drop from starting to running friction results in less jolt and smoother operation.

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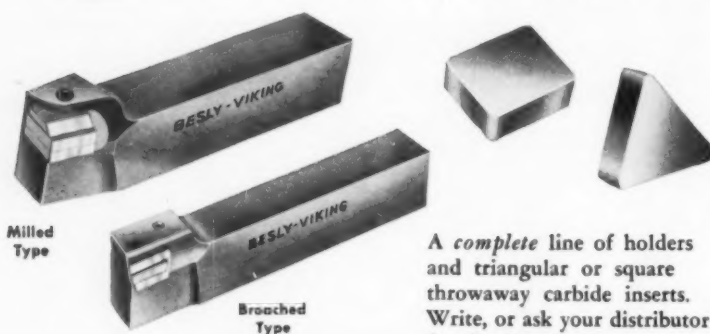
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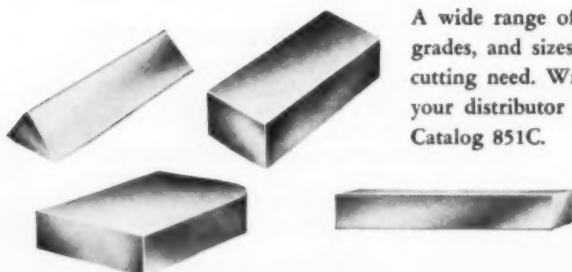
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SAFETY MANAGEMENT: ACCIDENT COST AND CONTROL—by Rollin H. Simonds and John V. Grimaldi. Published by Richard D. Irwin, Inc., Homewood, Ill. Price \$7.80. 568 pages.

This book is a comprehensive coverage of the principles governing the prevention and control of work accidents in business and industrial establishments. It shows how to calculate accident costs and how to detect production inefficiencies due to safety hazards.

Safety problems in connection with manufacturing and marketing new products will be of assistance to the practicing safety manager, as well as suggestions for disposal of liquid, gaseous and operational wastes. Appendixes list common industrial hazards, their occurrence and properties, and properties of selected flammable materials.

TITANIUM IN IRON AND STEEL—by George F. Comstock. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price \$6. 306 pages.

The author gives a general discussion of titanium and its minerals and then goes on and examines the properties and effects of the element as an additive to iron and steel. Its deoxidizing effects are discussed in full. Special emphasis is placed on its effect in stabilizing nitrogen and in fixing carbon in alloys where other carbides may be undesirable, on its usefulness in steel which is to be enameled, and in certain complex ferrous alloys for high-temperature application.

FOUNDRY PRACTICES—by S. E. Rusinoff. Published by the American Technical Society, 848 E. 58th St., Chicago 37, Ill. Price \$6.50. 273 pages.

The fundamentals of metal casting and foundry practice are presented in this text in a manner that will enable any person to obtain a better understanding of all foundry practices. Each subject is covered as a separate unit and useful tables are included wherever needed. Questions at the end of each chapter can be used for review purposes. Also at the end of the text there

The Tool Engineer

is a list of books and articles that can be used as a guide to further reading.

MAGNETIC MATERIALS IN THE ELECTRICAL INDUSTRY—by P. R. Bardell. Published by Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. Price \$10. 290 pages.

This book is intended to be helpful to senior students in physics and electrical engineering and to physicists and engineers in industry. It seeks to bridge the gap between an academic study of the properties of magnetic materials and the limited treatment of the subject possible in most textbooks for engineers.

One of its aims is to link the properties of materials with their applications. This treatment brings out clearly that the full realization of the high magnetic qualities of the modern materials is closely interrelated with the design of the systems in which they are to be utilized.

HELICAL SPRING TABLES—by John D. Gayer and Paul H. Stone, Jr. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price \$5. 175 pages.

This book makes it quicker, easier and simpler to design and specify springs to meet special requirements. It contains an easy-to-use index of over 6800 ready-designed compression and tension springs and data that can be used as a starting point in the design of springs.

Contained also are instructions and examples of how to use the tables to select the correct spring for every application.

A PROFESSIONAL LOOK AT THE ENGINEER IN INDUSTRY—Prepared by the NSPE Engineer-in-Industry Committee, National Society of Professional Engineers, 1121 15th St., N. W., Washington 5, D. C. Price \$3. 132 pages.

The publication reviews the major causes of dissatisfaction among engineers in industry and the background and current status of drives to meet the engineers' problems by the development of engineers' unions. After a study by the committee, they suggest a series of remedial actions by management and individual engineers in the fields of professional status, employment conditions and economic status.

Forty-six specific areas for improving the engineer-management relationship are suggested in the book.

The book recounts the specific engineering union activities and attitudes with respect to strikes, arrangements with trade unions, loss of leadership to nonprofessionals, advocacy of compulsory union membership and the efforts of trade unions to organize professional employees.

Charts and tables are used and there are more than 250 footnote references.

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6	How to clean magnesium. See pages 27 to 29.
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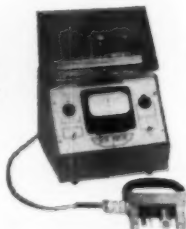
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what IS the PRODUCTION ENGINEERING function?

*Tech
Digests*

By W. P. Smith

Asst. Professor of Mech. Engineering
Michigan State University
E. Lansing, Michigan

PRODUCTION ENGINEERS HAVE the responsibility for developing and designing the entire method of manufacturing from raw materials to finished product. As our economy expands and the need for mass-produced items grows, the challenge to reduce manufacturing costs becomes increasingly great. To meet this demand, creative production engineering of a high order is required. However, a number of barriers currently stand in the way of production engineering progress.

Organizational Conflicts

Perhaps the basic problem retarding production engineering progress in many plants today arises from organizational conflicts and inefficiencies. Frequently these problems can be traced to a single source: an often unrealistic nonfunctional division of production engineering duties and responsibilities. The production engineering function encompasses process engineering and routing, methods engineering and motion study, tool design, materials handling system design, plant layout, time study and work measurement, machinery replacement analysis, and process and methods research and development. The fact that in many manufacturing plants these duties are scattered throughout the organization accounts to a great extent for the conflicts and inefficiencies which exist. To solve the problem, steps are being taken in many companies to bring these related functions under one roof.

Specifications

A second obstacle to production engineering progress is the inefficiency with which the production engineering plan is communicated to manufactur-

ing. Elements of a good communications system are: (a) the message must get through; (b) it should not be distorted or confusing; (c) there should be a minimum of redundancy or excess information transmitted. On all three counts, most methods of communicating production engineering plans fall very short of being efficient.

The most common methods of conveying such plans are production routings, operation instruction sheets, tool drawings, time study record sheets and plant layout drawings or models. It is probable that if identical specifications for the manufacture of a product were sent to a number of different plants, there would be numerous discrepancies in method, time and cost of manufacture, indicating where the specifications fell short of indicating the production engineer's intent.

be specified in a language which leaves nothing to chance, and in a language that is universally recognized. This certainly calls for a standardization of the symbols and notations used to describe processing plans far beyond anything we now know.

Creative Engineering

The inability of production engineers to think creatively holds back the progress of production engineering work more than any other single factor. Many production engineers, when faced with a manufacturing problem, jump immediately to a preconceived notion of the best solution. When the solution to every problem is based on the solution of some previous problem, originality is stifled.

A more logical procedure is needed. Fig. 1, one that seeks out the basic factors underlying each problem, and attempts to establish problem objectives and means of quantifying and measuring results. Steps in such a procedure would include:

1. Making a product analysis
2. Selecting alternative forms of raw material
3. Constructing a work list containing all of the elements of work that are required to make the product
4. Indicating alternative groups of unit processes that are necessary to satisfy each element on the work list
5. Combining unit processes into manufacturing operations for each alternative.
6. Arranging manufacturing operations into logical sequence
7. Evaluating alternative sequences of manufacturing operations from both economic and technological points of view
8. Selecting the optimum solution
9. Specifying the details of each manufacturing operation

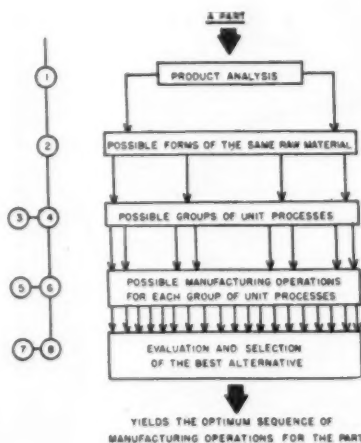


Fig. 1. Development of processing alternatives.

With increased competition for the customer's dollar, it will become necessary to predict the outcome of production engineering plans with greater accuracy. Methods specifications must

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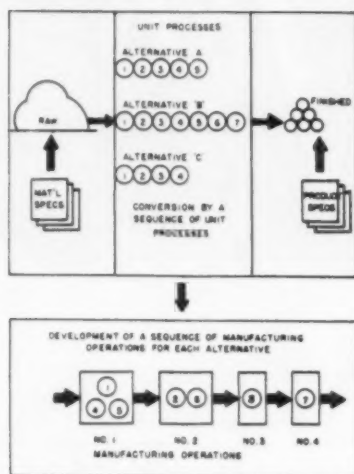


Fig. 2. Concept of unit processes and manufacturing operations.

10. Installing the system
11. Comparing actual results against estimates
12. Adjusting or changing the system until the desired results are obtained.

Unit processes, Fig. 2, are defined as modifications of a product done without essential interruption, and they do not indicate what machine or other equipment is used to perform the modification. Examples of unit processes are drilling, broaching, bending and shearing.

Analytical Tools

The problem of selecting the best alternative leads directly to the fourth roadblock facing production engineering progress. This is the need for the use of better analytical tools to study the behavior of production plans and processes. Although many mathematical tools are available to production engineers, attempts to quantify production engineering problems are often deemed impractical and empiricism is the guiding light. A change in this attitude is necessary.

Once the variables in a production system have been identified and their interrelationships equated, it is possible to utilize computers for the rapid solution of production engineering problems. Another approach to these problems is the use of simplified working models and pilot plants, a technique which has long been used in the chemical industry but has been rarely applied to the mechanical field.

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Training

Perhaps the key to increasing the use of sound analytical tools is the development and training of production engineering personnel of high caliber. The problems of production planning and engineering are so complicated that the best brainpower available should be encouraged to tackle them. In our engineering schools, courses should be developed that utilize to the fullest possible extent the physics, mathematics, mechanics and metallurgical backgrounds of the student engineer. Courses that only teach the student how to run a machine or grind a tool bit are of marginal value to the production engineer of the future. He must be an accomplished statistician because his problems contain many interacting variables. He must have a fundamental understanding of psychology and biology as well, since he must design systems containing human beings as well as machines. This job can only be filled by highly analytical and creative people with engineering education of a high order.

From paper 56-SA-49 given at the ASME Semi-Annual Meeting, June 1956, The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.



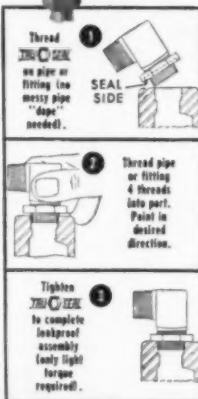
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Progress Report on Large Forging Production

By J. R. Douslin

Plant Superintendent
Wyman-Gordon Co.
Worcester, Mass.

As a result of wartime development, the conclusion was reached that magnesium, particularly when alloyed for maximum strength, could be successfully forged only on presses. This conclusion on the forgability of magnesium may have been the spark to initiate the heavy press program, Fig. 1.

Development of light alloy forgings has been intertwined with this heavy press program. In fact, the first forging to come off the first heavy press was a large chemical mortar base of magnesium produced in the thousands.

During early years, efforts to utilize large magnesium forgings in highly stressed aircraft applications were disappointing. The scatter band of physical properties in large magnesium forgings was undesirably broad and the lower limit was undesirably low. This,

tech digests

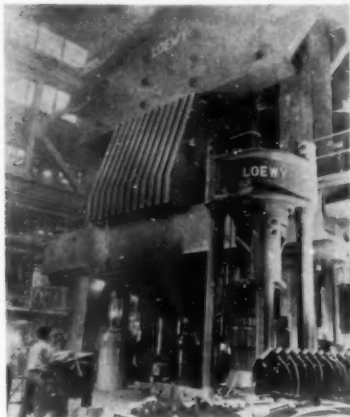


Fig. 1. New 50,000 ton press for production of large forgings.

coupled with inherent caution on the part of designers using a new material, caused large magnesium forgings to fall into some disrepute, particularly in highly stressed applications.

As more forgeable, more ductile alloys become available, applications have begun to increase. Considerable interest is being shown in a forged aircraft landing wheel. Another outstanding application is in the helicopter for rotor hubs. They are used under conditions of dynamic loading in an area where weight has an important bearing on balance and stability.

Considerable strides have been made in improving quality of existing forging alloys and parts such as shown, Figs. 2 and 3, can be produced in volume.

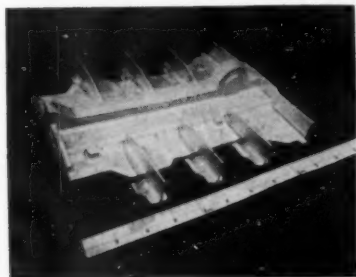


Fig. 2. Aluminum alloy rib cord of 0-deg draft, weight 86 lbs.

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Fig. 3. Wing rib forgings of close tolerance, draft 1-deg and 3-deg.

The heavy presses also are producing aluminum, titanium, steel and high density alloy parts so that magnesium forgings are only a small part of current production. The future of light alloy forgings rests in part on their competitive position with other metals.

From a paper presented at the Nov. 1955 annual convention of the Magnesium Association.

Automatic Gaging

..... Why, How, When

By W. C. Mullin

Gage Sales Engineer
Pratt and Whitney Co., Inc.
West Hartford, Conn.

Automatic gaging can contribute definite benefits such as lower costs, higher production rates, or greater efficiency to industry. Two types of automatic gaging are available: "in-process" gaging, in which piece parts or processes are gaged as machining operations are being performed, and "post-process" gaging, which is done subsequent to machining.

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tech digests

In-Process Gaging

In-process gaging units are generally mounted directly on machines and contact piece parts as they are being made. A simplified application of automatic in-process gaging to a lathe, grinder or similar machine is shown in Fig. 1. In this operation, part size information picked up by the gage head is used to control the machine slide. If a workpiece is oversize, an amplified current from the gage head causes the feed screw to turn until the amplified current reaches a zero value, indicating that the required workpiece size has been reached.

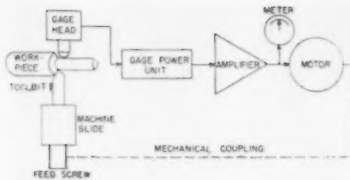


Fig. 1. Schematic diagram of automatic in-process gaging system for applications such as a boring machine or lathe.

An ideal arrangement would be to have a series of machines in an integrated line, with each machine performing a specific operation. A gage at each machine could be used to monitor that particular operation, preventing the machine from making bad

parts. This would insure that the efficiency of the line would remain high and that only good parts would be transferred from one operation to the next. The major problem here, however, is that in-process gaging is not applicable to all types of machining operations. It is most suitable for ID and OD grinding and turning and for various types of surface or flat grinding.

Post-Process Gaging

Two methods of post-process gaging are used. The first is termed a continuous feedback control system, and is used for proportional control of grinders when it is not practical to measure a workpiece as it is being ground. In this system, Fig. 2, each completed workpiece is used to reset the machine for the following workpiece. The gage measures the workpiece by position of

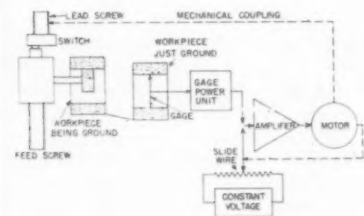


Fig. 2. Schematic diagram, post-process gaging, as applied to a grinder.

the switch which stopped the grinder cycle. If the size is correct, no error voltage will be applied to the motor to reposition the switch. When the size is incorrect, the motor shaft will turn in the appropriate direction to either find a new position on the slide wire to reduce the error signal to zero, or reposition the switch which controls the feed stop on the machine.

In the second method of post-process gaging, dimensional control zones are set up as illustrated in Fig. 3. Parts are fed into a gage as they emerge from the machine, and the dimensions in question are measured. If they fall within pre-control tolerance limits, no correction is necessary and the machine receives a signal to produce a second part. This sequence continues as long as all of the parts fall within the pre-control zones. If dimensions of two successive parts fall outside of these zones, an impulse transmitted from the gage to the machine produces an appropriate machine correction to bring parts back within tolerances. When two successive parts fall outside of the extreme tolerance limits, the machine shuts down and signals that operator attention is needed.

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Control Gaging Versus Inspection

Both in-process and post-process gaging systems perform very well on machine tools that are capable of operation with automatic controls. At present nearly all machine tool builders are producing machines that are or can be equipped with automatic gaging.

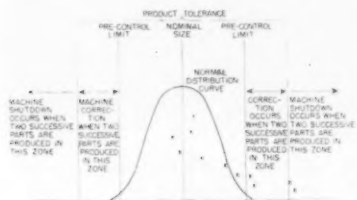


Fig. 3. Zone control for post-process gaging, based on probability curve.

However, if circumstances make it necessary to utilize older machines which are not capable of the very small increments of adjustment that are sometimes required, it is foolish to spend money in the expectation that these machines can give high performance.

In such cases, it is generally more desirable to locate fixture-type gages in the machine area so that the operator can periodically check the parts being made and make machine adjustments manually. If desired, automatic inspection machines can be used to sort good and bad parts.

From a paper given at the 20th Annual Machine Tool Electrification Forum, April 1956. Westinghouse Electric Corp., 401 Liberty Ave., Box 2278, Pittsburgh 30, Pa.

New Plastic Tooling Material

By James Ross
General Mills, Inc.
Research Laboratories
Minneapolis, Minn.

Plastic as a tool and die material is still an infant in early stages of what can be a tremendous growth. Spurring this growth is development of many new and useful materials. One of these is Versamid, a polyamide resin. In laboratory test, these resins, when used with epoxy resins, have shown many desirable properties of interest for plastic tooling.

This new combination has several properties that make it look promising as a tooling material. For example, it



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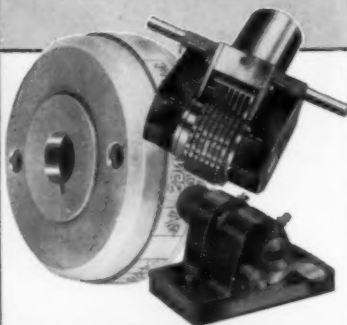


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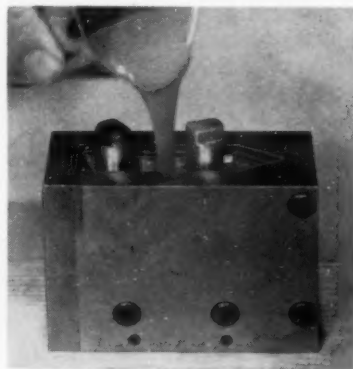
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by Parker

tech digests

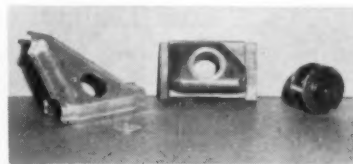


1. Soft jaws for lathe chuck are produced by pouring of plastic in a divisible mold.

shrinks little in casting, possesses great strength and impact resistance, is not porous and has a high degree of adhesion.

Another advantage is that Versamid has shown no evidence of toxicity. By comparison, workmen using some other epoxies are required to use protective devices such as face masks, skin ointments and special clothing and gloves.

In reaction heat, the new combinations also show advantages. They can be used for large castings since relatively little heat is given off when epoxy is mixed with the polyamide resin. 50-lb. compacts have been made without ill effects. In contrast, reaction heat within such castings often gives rise to bubbles, such as form in boiling water. These remain incorporated in the casting so it is no longer useful as a solid, but is a weakened block full of holes.



2. Metal insert in plastic die makes economic production of aircraft part at left in combination forming—blanking die.

Some laboratory tests have shown that in certain proportions, the resulting resin is highly resilient—a valuable property for such uses as facings on drop hammer dies.

Although more costly than some other plastics and less heat resistant than phenolics and polyester, the new mate-

The Tool Engineer

tech digests

rials show promise of being top caliber tooling materials. They are used with glass cloth or fiberglass of any kind as reinforcement when extreme ruggedness is necessary as in forming dies, or when extreme dimensional stability and lack of shrinkage is needed as in checking fixtures on master models.

These plastics are now in the factory testing stage. There they have been used for vise jaws, soft jaws for boring lathes and also in short run aircraft tooling.

From a report in "Progress Through Research," volume 10, number 1, 1956, General Mills Research Laboratory, Minneapolis, Minn.



Progress Report on Magnesium Plaster Castings

By E. J. Willis

Development Div.
Aluminum Co. of America
Cleveland, Ohio

Use of plaster molds, while relatively new, is finding applications where normal sand castings never quite hope to compete. Plaster molds are produced by a water mixture of gypsum strengtheners and setting agents. The molten metal is poured into this plaster cavity. Better tolerances and smoother physical surface conditions are secured, as well as reduced cost of the final part through elimination of machining. Usefulness of this process needs to be understood both by foundrymen and designers so that castings

Medium size plaster mold casting of magnesium with thin sections.



made by the process will provide necessary surface and critical dimensions without penalizing the cost.

Size of castings which can be made in magnesium range from less than an ounce to over 100 lbs at the present time. Surface finish obtained on magnesium sand castings varies considerably, but in general, the surface will be between 400 and 1000 microinches. When plaster is used as the mold material, surface finishes in the neighborhood of 100 microinches are common. Finishes as low as 50 to 60 microinches can be found in some areas on the casting. Depending on conditions, special care can be exercised to obtain exceptionally smooth surfaces in specific and limited areas.

Production of magnesium castings by plaster process indicates that all normal magnesium alloys which may be sand cast may be cast as well in

FOR AVAILABILITY OF COMPLETE PAPERS WRITE THE HEADQUARTERS OFFICE OF THE SOCIETY NOTED AT THE END OF EACH ABSTRACT.

plaster molds. The usefulness of the process may also extend to magnesium rare-earth zirconium and magnesium thorium zirconium alloys. There are many jet engine and guided missile applications which may soon require these alloys for proper functioning.

Tolerances on the order of 0.010 inch for the first inch and an additional 0.001 inch for each additional inch of length are typical. At many points in castings using plaster cores and plaster molds, zero draft is permissible. However, as a general rule,



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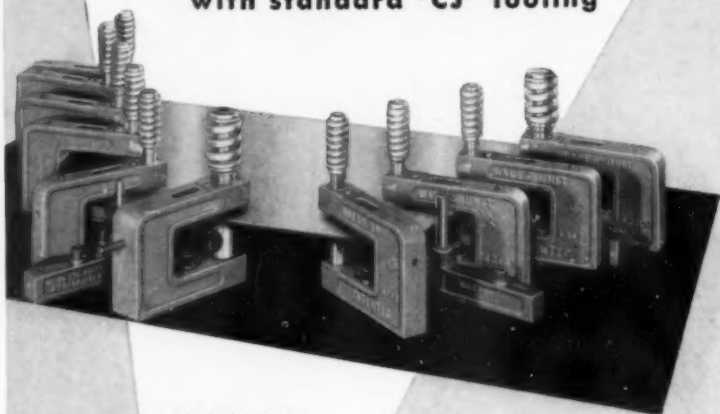


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tech digests



Typical small mechanical parts produced from plaster mold castings.

2 deg is desirable. Sections as thin as 1/16 inch have been produced under circumstances, but the minimum thickness should more typically be considered as about 1/8 inch, over any 6-inch linear dimension. Examples of what can be produced are shown in the accompanying illustrations.

As use of plaster castings for magnesium becomes better known, it is believed that plaster will be used in conjunction with sand cast processes, as well as with permanent mold castings. From an economical standpoint, plaster castings will be considerably more expensive than green sand and should be used only where specific reasons require them.

Results indicate that the same yield-strength can be produced in castings with thin sections as sand-cast magnesium, while tensile strength and elongation are slightly less in plaster. In thicker sections, it is expected that there will be few cases where both sides of the section would be produced in plaster.

It is felt that many uses for magnesium plaster castings only await proper publicity before industry demands them for apparent savings. A gradual increase in size of castings may be secured. As foundries become more familiar with the plaster process, better tolerances and better surface finish control may be expected.

From a paper given at the Magnesium Assn. Annual Convention, 122 E. 42nd St., New York 17, N.Y., Nov. 1955.



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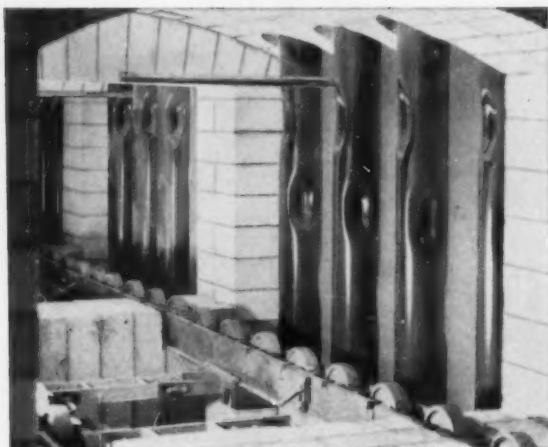
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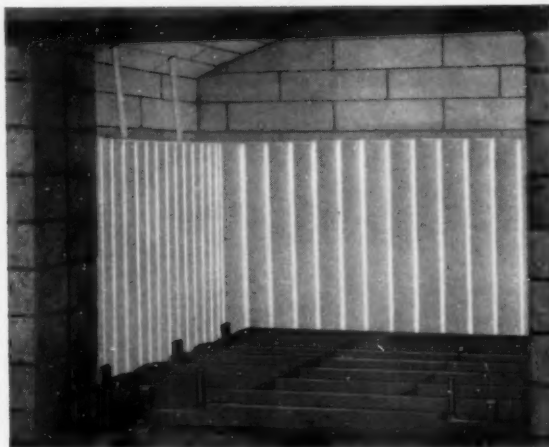


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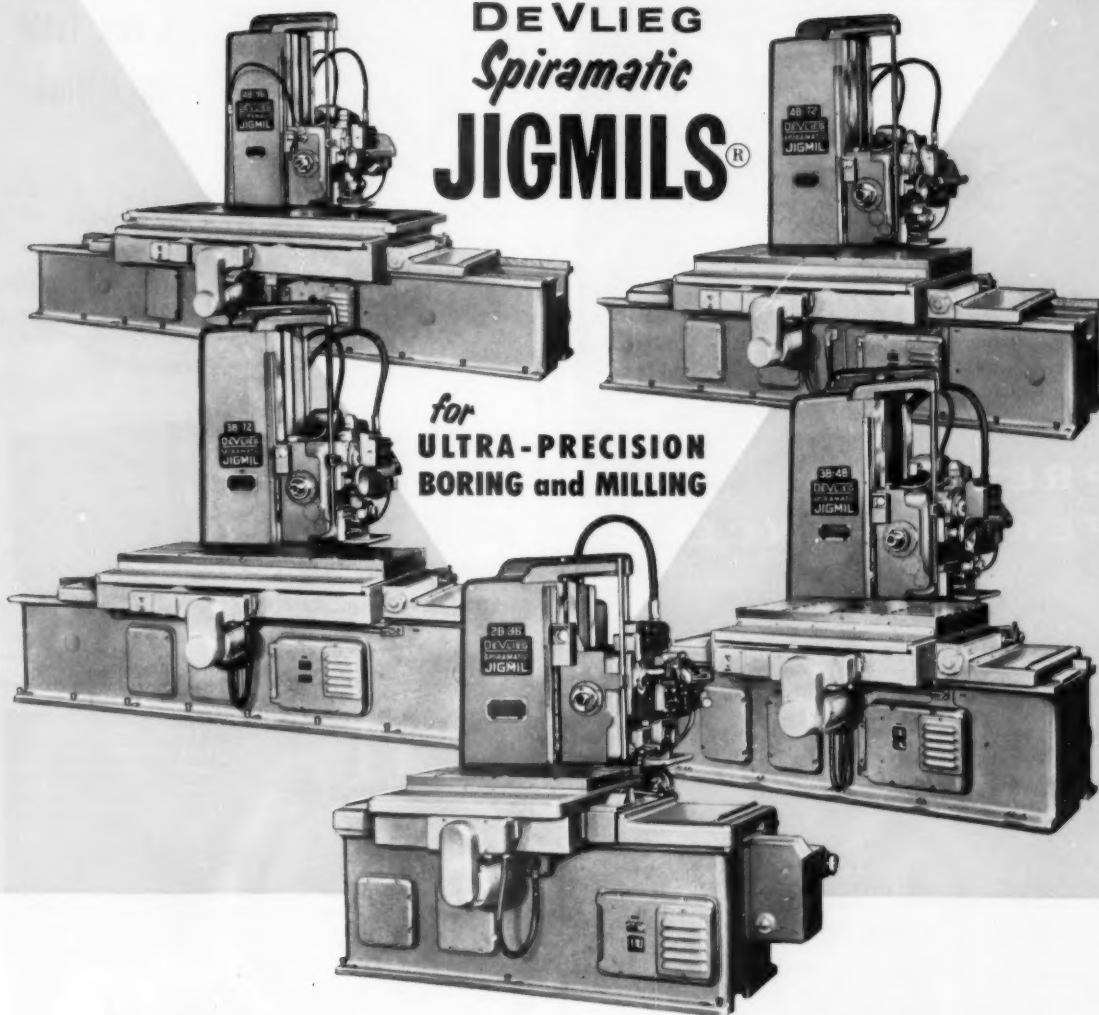
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~~1000~~
~~400 sfpm~~

~~depth of cut - .125~~
~~.005~~

~~1250~~
~~sfpm - 800~~

~~"unmachinable"~~

~~2000~~
~~250 sfpm~~

~~65~~
~~pieces per hr. - 20~~

~~505~~
~~HS-Steel - 90 sfpm~~

~~1175~~
~~SAE 1035 - 250 sfpm~~

~~4~~
~~min. per cut - 40~~

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This compact plastic box provides a practical container for ten Stupalox sintered oxide inserts.

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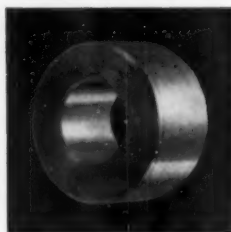
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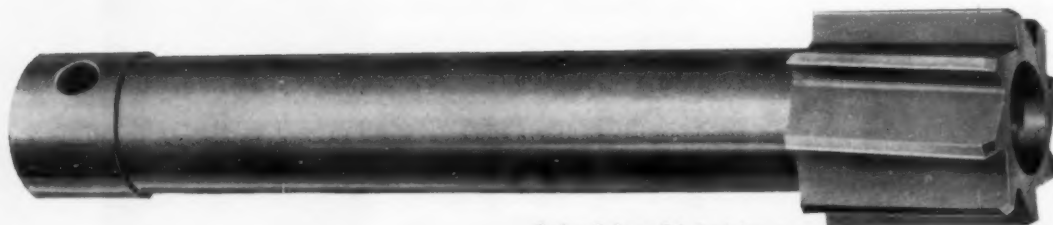
Consistent duplication of accuracy

Minimum finishing stock

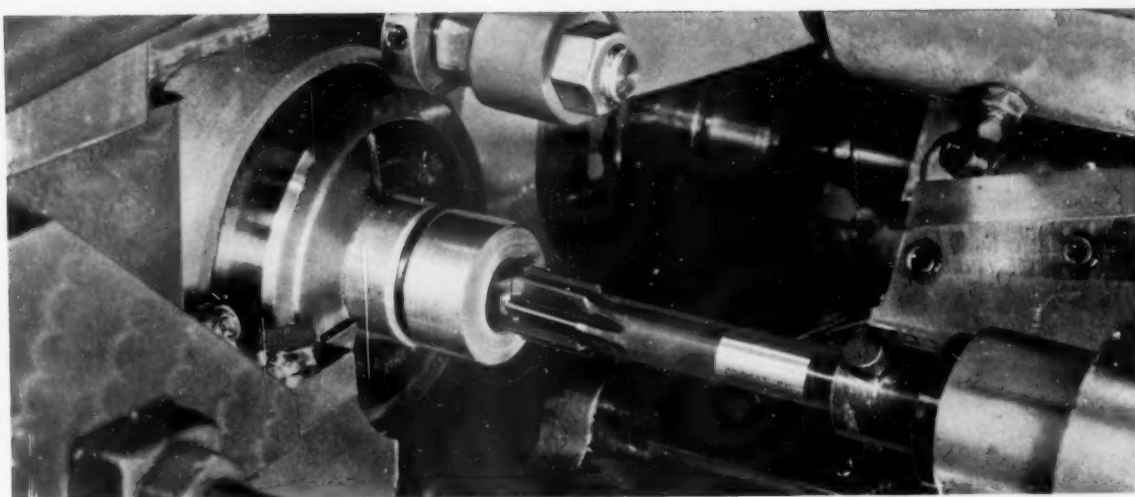
Fewer finishing operations

Important job economies are being obtained in hole finishing operations with Barber-Colman standard "oil feed" reamers. Close control of size and finish reduces the number of finishing operations required and results in shorter finishing time. Because reamer diameters are held to a tolerance of $+.0002"$, $-.0000"$, reamers can be drawn from stock and put to work immediately on the machines, with assurance of consistent hole accuracy. This eliminates the usual machine downtime for hand working the reamers and size checking.

Through careful tool design and accurate sharpening, reamers are made to suit the specific job characteristics, so that better cutting action produces fewer stresses, and



Barber-Colman Oil Feed Reamer



consequently less distortion in heat treating. As a result, less finishing stock is required for honing after hardening.

Cost savings benefits such as these are evidenced in the Barber-Colman "oil feed" reamers used to size bores in planetary gear blanks. Blank bores are finished within .7536"/.7543" I.D. to 15-60 rms. Since reaming produces blanks within the close tolerances required for accurately cutting the gear teeth, a series of successive finishing operations formerly required have been eliminated, greatly reducing cost per finished hole. Minimum stresses produced as a result of reaming confine heat treating distortion to normal shrinkage of the hole. Consequently, in this case, the hole is reamed to final size, and it is only necessary for honing to remove the amount of shrinkage. The job facts as shown illustrate the production accuracy and finish obtained:

Barber-Colman reamer design produces sharp cutting edges with positive primary clearance on the land, rather than a cylindrical land, to provide a shearing action cut. These sharp edges with irregular flute spacing produce smooth cutting with uniform finish and accuracy which cannot be obtained with conventional reamers. These reamers also have a slight right hand helical flute with

an oil hole drilled through the center of the reamer so that the cutting oil will force the chips back between the flutes, contributing to fine finish.

Semi-Finished Bore Diameter	.7536"/.7543"
Maximum Taper Allowable	.0001"
Bore Square and Parallel with Face of Blank	.0003"/.0005"
Concentricity with O.D.	.002"
Production	200 Blanks per Hour
Cutting Time	17 Seconds
Cutting Speed	302 rpm.
Stock Reamed	.008" to .009"
Finish	15-60 rms.
Bore Depth	.820"
Feed	.025"

When you have hole finishing problems involving close limits of accuracy and a series of operations, call a Barber-Colman reaming expert and talk over with him the most economical way to get the finish and accuracy you want. You will find substantial production savings possible, both in cost and time.

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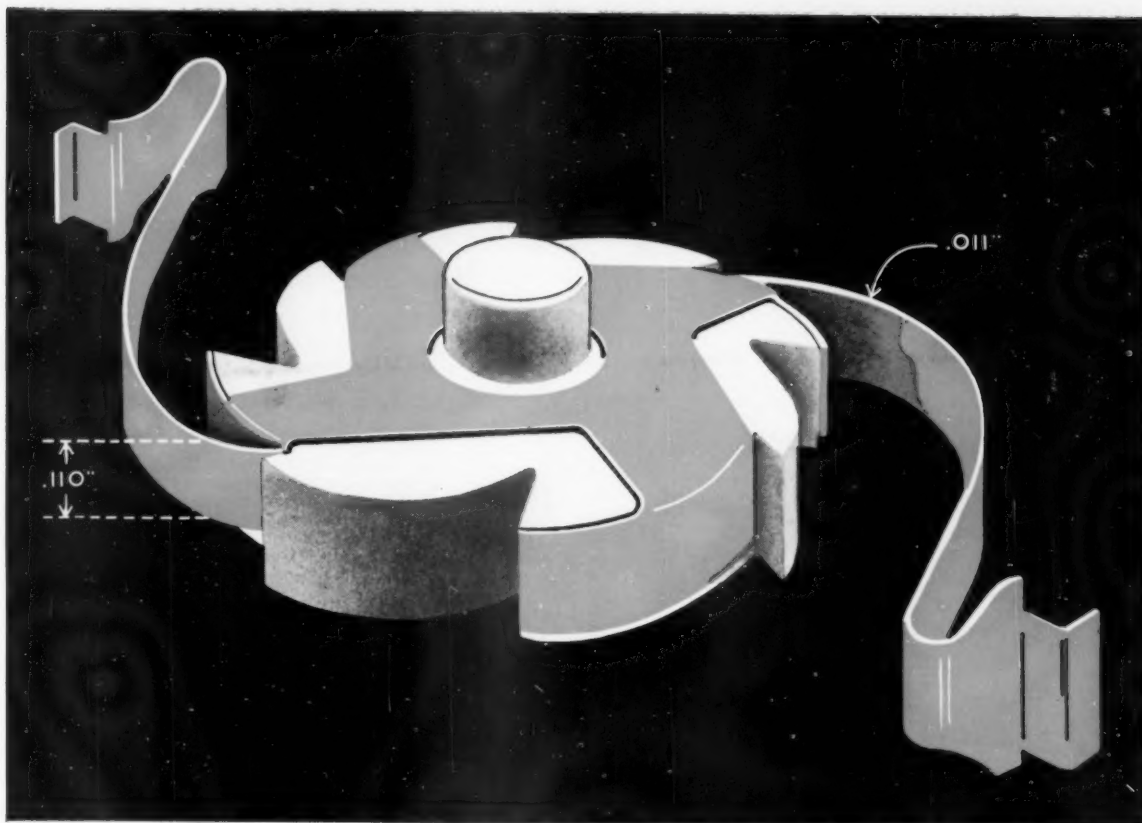
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Cutaway of Levolver Switch No. 41 shown approximately actual size.

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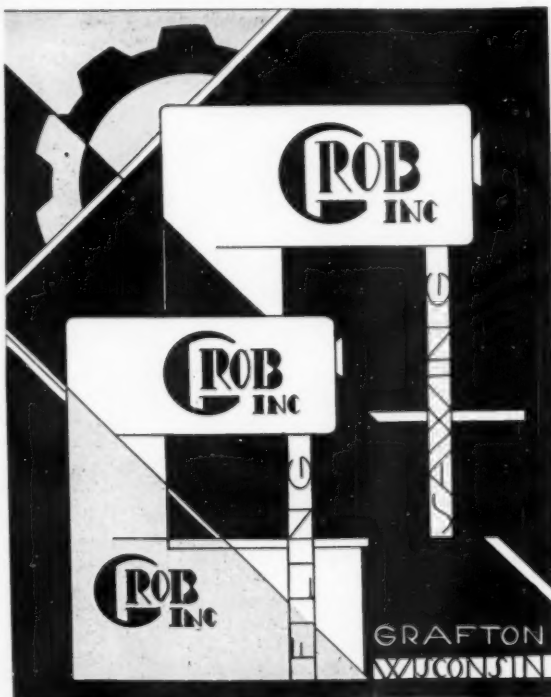
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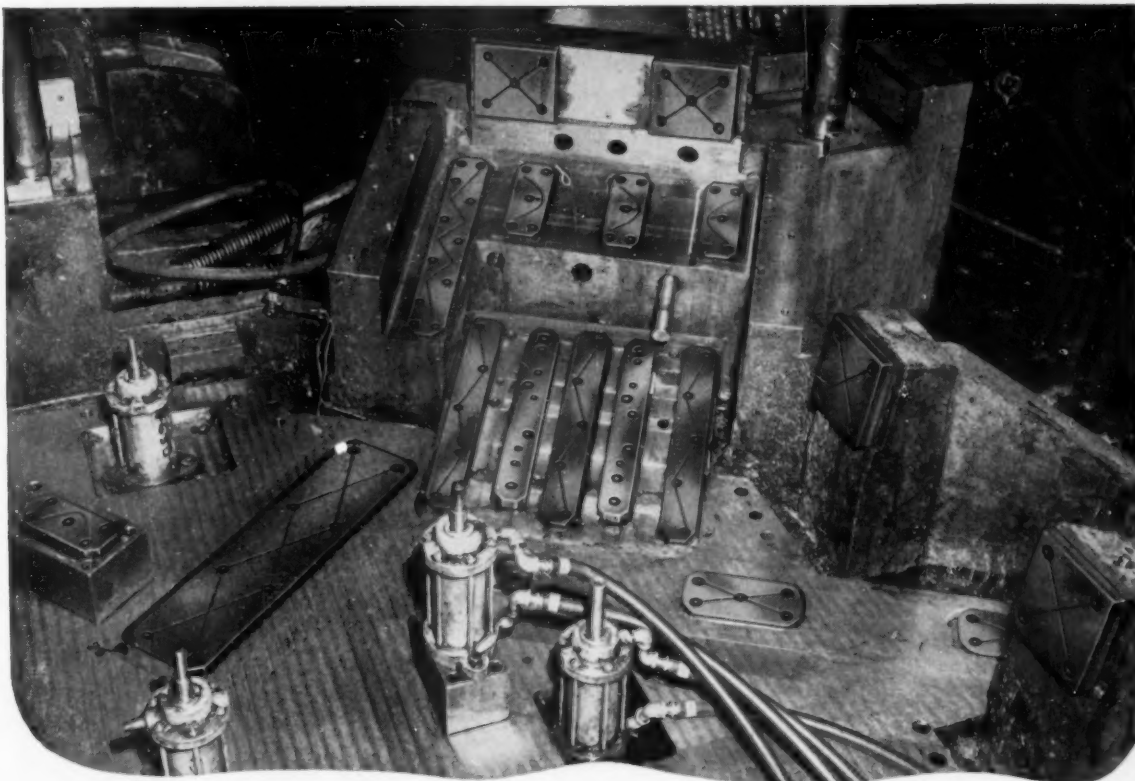
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For free bulletin "SLITTING—A Basic Guide
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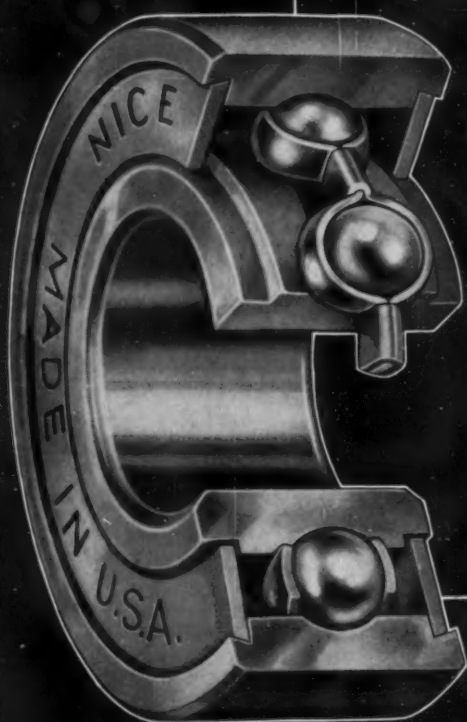
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Why Sterling adds a sixth element to your grinding wheel formula

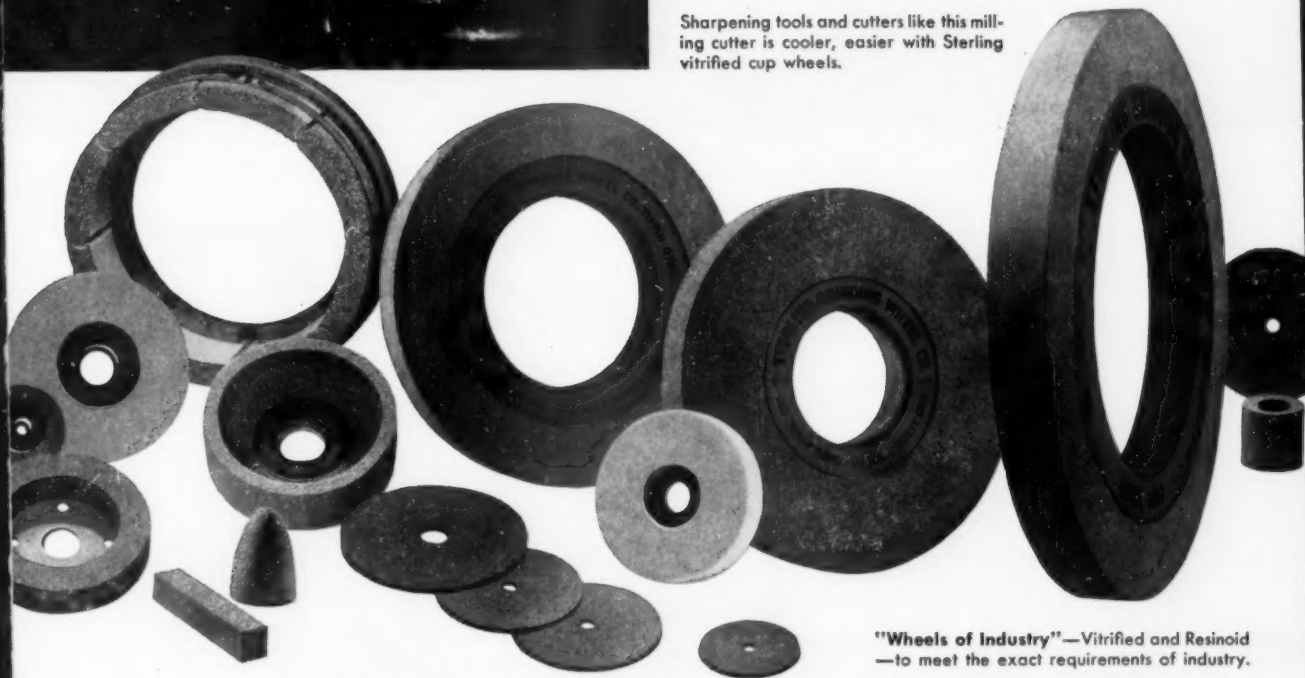


YOUR GRINDING WHEEL'S performance is determined by the five elements that make up its specification: abrasive grain, size, grade, structure, and bond. But in determining the precise formulation of these five elements, Sterling always considers a *sixth* element.

The sixth element is the *human* element: the operator himself, his work habits, personal preferences, and all the other little things that make your job unique. Considering the vital sixth element may mean the difference between success and failure on any grinding operation.

Sterling grinding wheels—formulated with the sixth element in mind—can cut your grinding costs, reduce grinding time, and get maximum production from your machines. That's why it's sound practice to call in a Sterling Abrasive Engineer, or your nearest Sterling Distributor, for a complete study of your grinding operation. Do it soon.

Sharpening tools and cutters like this milling cutter is cooler, easier with Sterling vitrified cup wheels.



"Wheels of Industry"—Vitrified and Resinoid
—to meet the exact requirements of industry.

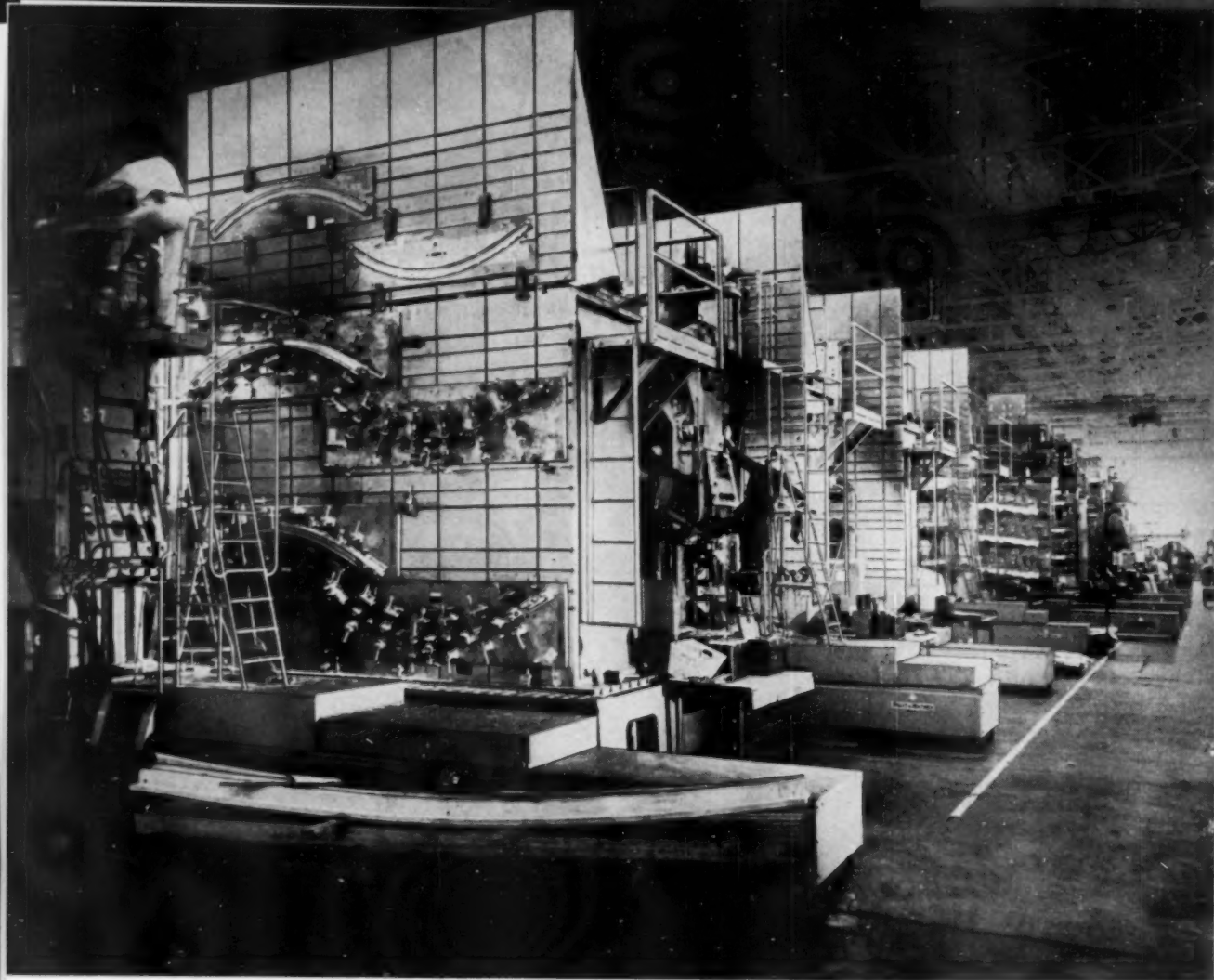
STERLING

GRINDING



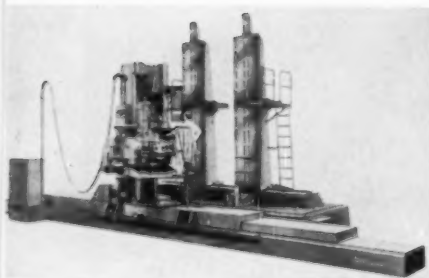
WHEELS

STERLING GRINDING WHEEL COMPANY, TIFFIN, OHIO—SUBSIDIARY OF ABRASIVE AND METAL PRODUCTS COMPANY



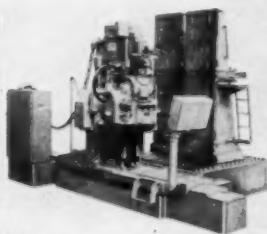
GIANT

shape the future

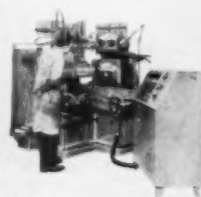


MULTI-MILLION DOLLAR PLANT... OR SMALL SHOP—There's a complete line of Pratt & Whitney KELLER Machines with models to handle *every* work size profitably.

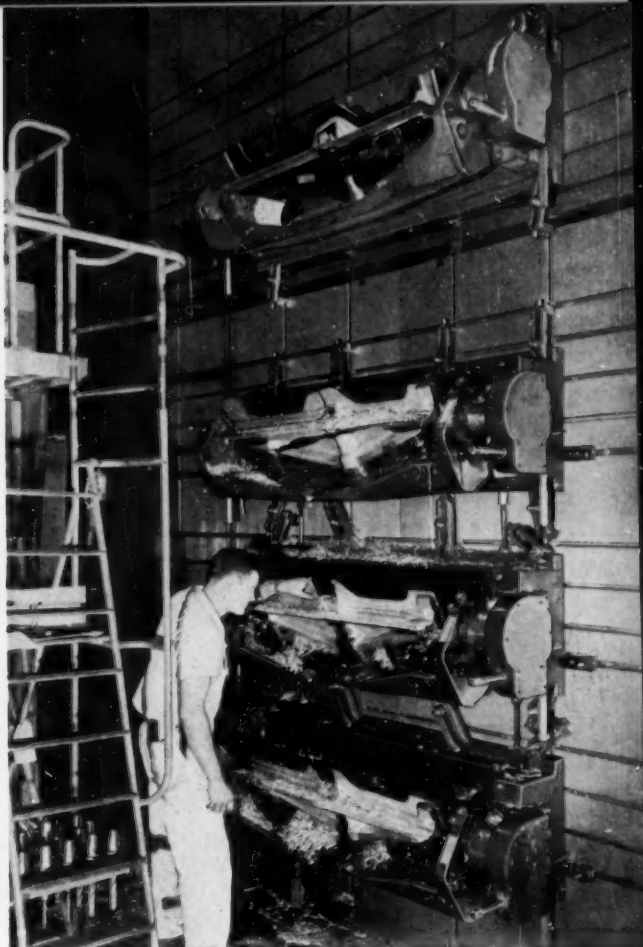
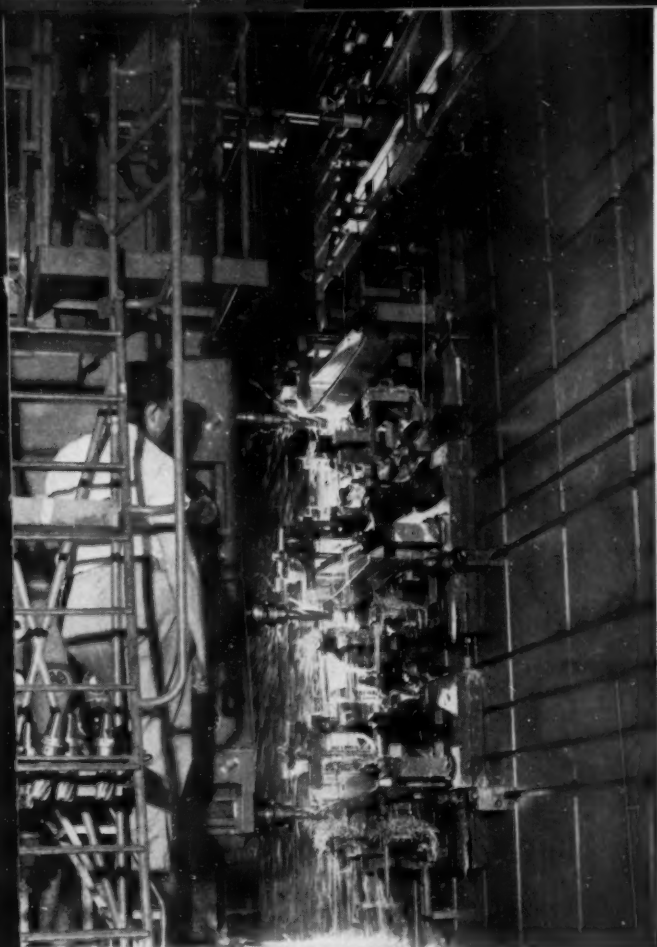
TYPE BG-22—A big machine with capacities to 20' x 7'. Single and 3-spindle models.



TYPE BG-21—Two standard sizes: 5' x 2½' and 6' x 4'. Single and 2-spindle models.



TYPE BL—Smallest KELLER with capacity of 36" x 20". Single and 3-spindle models.



The use of two and three-spindle KELLERS provides rapid output geared to tight schedules. One noted manufacturer is counting heavily on KELLERS to help produce 150-foot airliner wings on a five-a-month basis and fill \$90 million worth of orders.

Augmenting the already great versatility and productivity

built into all KELLER Machines, Tool Engineers have developed ingenious trunnion fixtures (like those shown in the adjacent picture) that make it possible to re-position the components quickly for several successive machining operations . . . without production stops to remove the work and change fixturing.

KELLERS

of jet age production

These on-the-job scenes taken in the plant of a leading aircraft manufacturer typify the swing to KELLER throughout the Aviation Industry. To provide the maximum strength-with-lightness necessary to withstand the terrific stresses of jet age flight, increasing numbers of large, complicated components are being forged as single units and

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GET THE FACTS . . . See how PRODUCTION MILLING with a Pratt & Whitney KELLER Machine can help improve your product performance and cost picture. Write for fully illustrated circulars, stating your work size ranges . . . or phone the Pratt & Whitney Machine Tool Specialist in your area.



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\$18⁵⁰

List Price*

*\$18.50 is the list price for the 1/4" port size and \$19.50 for the 3/8" less usual quantity discounts.

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for Air and Cost-Minded

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Important Savings	Low initial cost. Need no oilers and filters (time and materials savings).	All components are corrosion resistant.
Low Maintenance	Sealing qualities do not diminish with long, continued use.	Wear compensating "Shear-Seal" design.
Long Service Life	No production delays. Maintenance (rarely needed), without disturbing plumbing.	Lapped metal to metal sealing members.
Not Critical to Dirt	No scoring or binding. (As with spool or poppet designs.)	Flow is through "Shear-Seals." Sealing surfaces remain in constant intimate contact.
No Creeping Cylinders	Leakproof closure. (No internal port to port leakage.)	Maintained through lapping action of each operation.



Ask for bulletin A-5.

Foot operated models with or without spring return to reverse or to center are \$24.50 list for the 1/4" and \$25.50 for the 3/8" valve less quantity discounts.

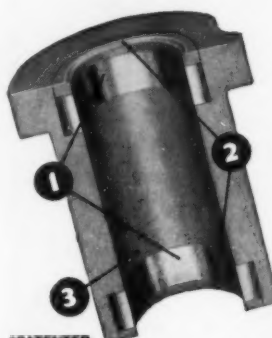
BARKSDALE VALVES



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SAVE TIME & MONEY**



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1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body.

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MEYCO

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Are Doing It Daily!**

How? Like this: (1) Last longer ... with a life—in most cases—as long as solid carbide bushings at prices that approach the price of steel bushings; (2) Increased life for your drill jigs and fixtures; (3) Increased life for your drills and reamers; (4) Accuracy maintained for a LONG PERIOD of time; (5) Less non-productive machine time, less lost man-hours, because bushings need not be changed as often; (6) Inspection time saved, because of greater accuracy for a longer time; and (7) Less waste due to spoilage, for the same reason. Don't pass up a good bet! Get the dope on MEYCO Carbide Inserted Drill Jig Bushings today!



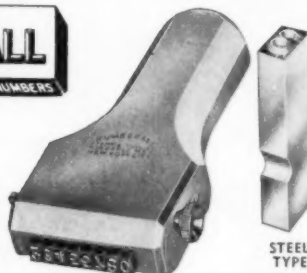
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MODEL 24

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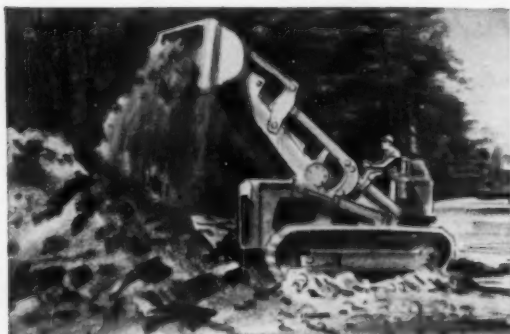
THE *Staples* TOOL COMPANY

2352 Glendale—Milford Road, Evendale, Cincinnati 18, Ohio

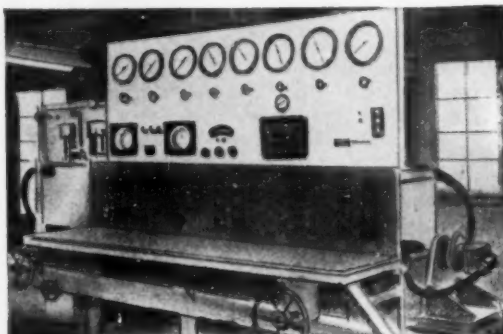
Staples

ROTATING
CARBIDE
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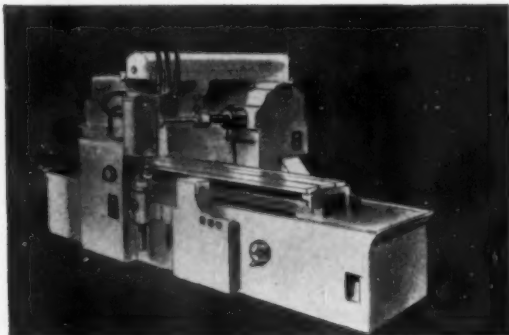
How hydraulic systems are simplified with 2000 psi vane pumps



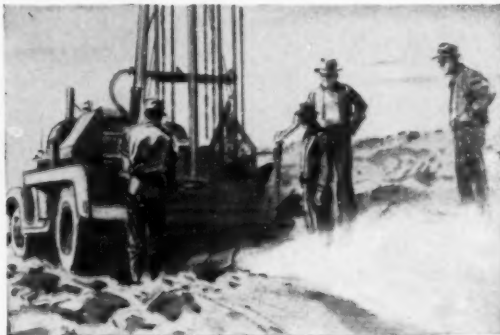
Lower weight on mobile equipment with smaller size lines, smaller controls.



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Higher torque, higher horsepower per GPM—continuously on drilling equipment.



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cover the entire range of
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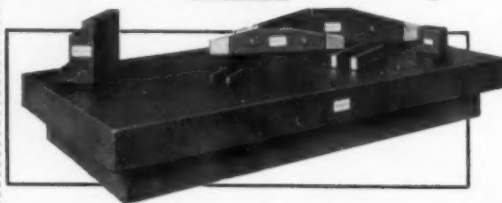
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TOOL COMPANY, INC.
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ROUSSELLE



THESE 40-TON PRESSES

take job after job in stride and give you top speed and uniform output on a variety of work. They stress simplicity in every detail to achieve quicker set-ups, easier changeovers and simpler operation. All are extra rugged, high precision units, made to withstand hard usage and assure long, satisfactory service. They are very moderately priced.

Significant savings may result if you let our engineering staff assist you. There is no obligation.

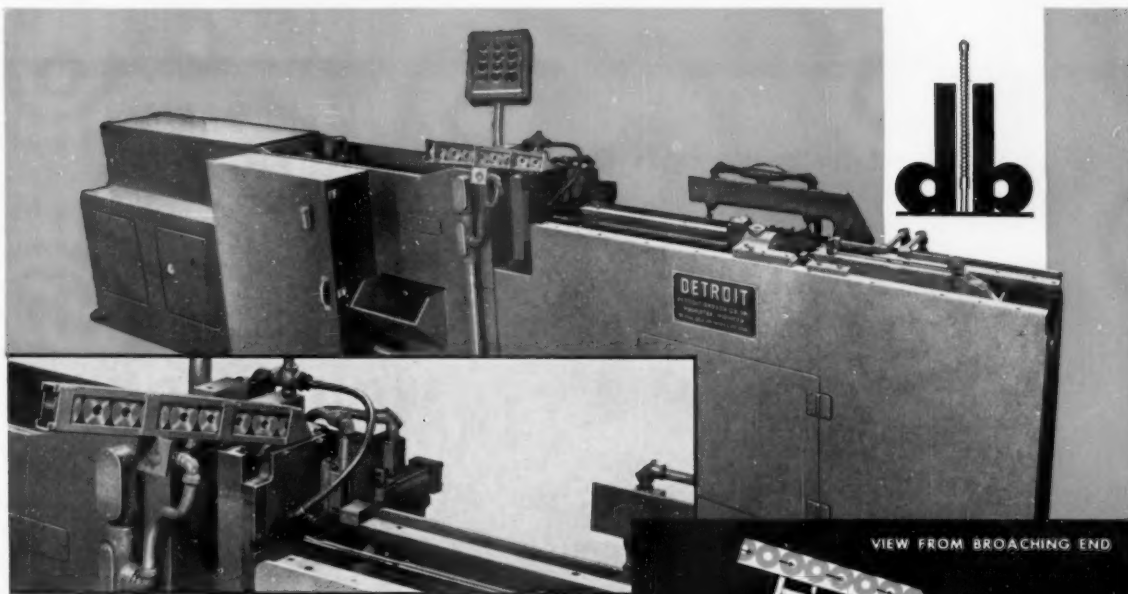
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Manufacturers of Rousselle Presses
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ENGINEER, USE THE HANDY READERS SERVICE
CARD ON PAGE 165.



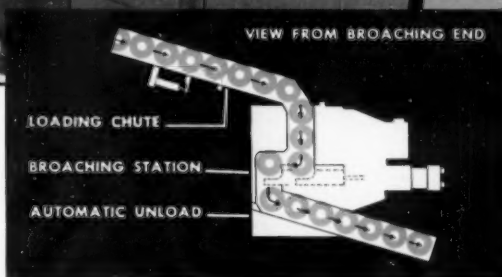
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- **Sizes I.D. and holds it concentric with Spline P.D.**
- **Completely automatic 8-second cycle**

This 3-ton, 36-inch stroke Detroit Horizontal Broaching Machine is inexpensive, fast, and offers automatic operation, tool handling and work ejection. While manual chute loading is illustrated, optional automatic loading is easily accomplished.

During its 8-second automatic cycle the machine accurately sizes the I.D. and broaches 19 precision internal splines, keeping them 100% concentric with the I.D. Thus, subsequent operations are performed more easily and economically because of simplified work location and improved accuracy.

This simplicity with high production is typical of Detroit Broach & Machine Company engineering. Detroit builds every size and type of broaching machine, and will automate and tool them to fit your needs. Discuss your production problem with a Detroit field engineer, or send us details . . . today.



THE CYCLE

- 1 Part drops through chute into "LOAD" position
- 2 Loader pushes part into broaching position
- 3 Loading signals automatic tool handling mechanism to move broach in to engage broach puller
- 4 Broach is pulled through work to end of pre-set stroke
- 5 Loader returns, broached part drops into unloading chute, next part drops into "LOAD" position
- 6 Returned loader signals machine to return broach to tool handling mechanism.
- 7 Machine slide stops, tool handling mechanism returns broach to "START" position
- 8 Cycle repeats . . . EVERY 8 SECONDS!

**DETROIT
BROACH
& MACHINE COMPANY**

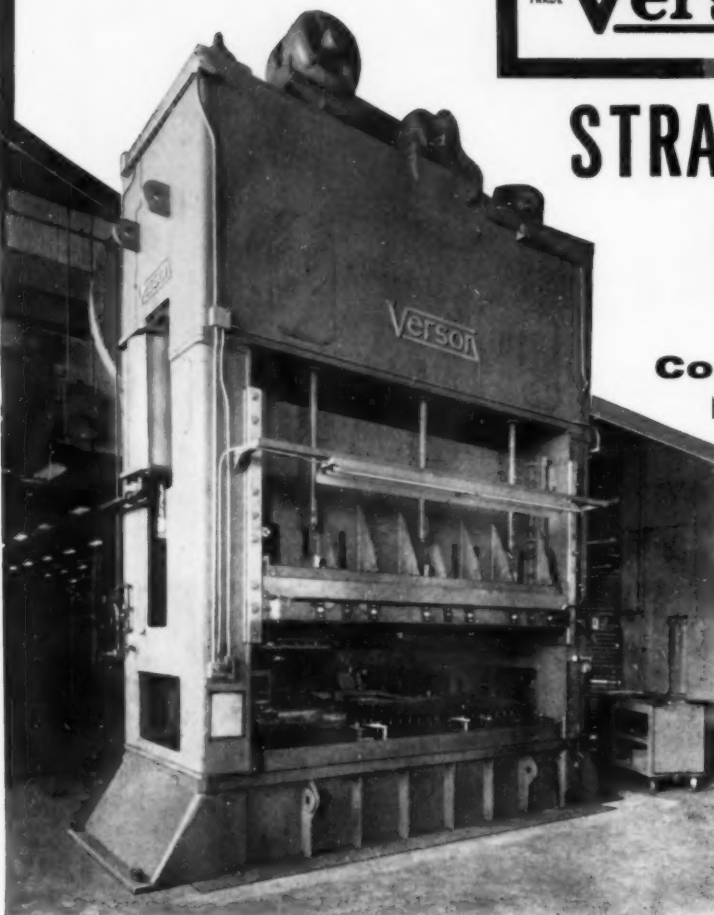
DEPARTMENT D-8
ROCHESTER, MICHIGAN

By Combining High Output with Adaptability



STRAIGHT SIDE PRESSES

**make
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More Efficient**



400 ton Verson Allsteel double crank, single action press used for a variety of large area stampings at Northern Metal Products Co., Franklin Park, Illinois. Bolster area of the press front to back, right to left, is 60" by 120".

Versatility, adaptability and top quality performance of Verson straight side presses are allowing the contract stamper to bring production line efficiency to his shop. An example is this 400 ton Verson double crank press shown above, used for large area stampings at Northern Metal Products Co., Franklin Park, Illinois.

Verson Allsteel Straight Side Presses utilize the great uniform strength of rolled steel plate for their frames to minimize tool damaging deflection . . . and

provide cleaner stampings, better draw section and savings in tool dollars. Square type gibs insure perfect alignment—nonoscillating adjusting screws assure long life and easily maintained accuracy.

This is the type of engineering for which Verson presses are noted. To a contract stamper it means greater efficiency and production with reduced costs.

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A Verson Press for every job from 60 tons up.



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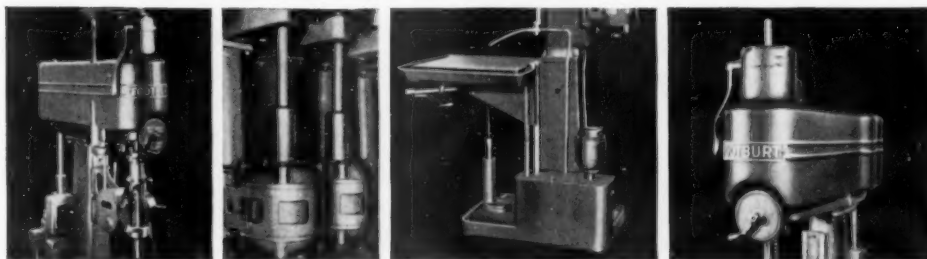
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A FULL RANGE DRILLING MACHINE ENGINEERED FOR PRODUCTION

■ Built carefully to provide the required accuracy for fine tool room work, Footburt Sensitive Drilling Machines are designed with the weight and stability to maintain close tolerances on day after day production work. The correct speed for a wide range of drilling, reaming, and counter-boring operations is instantly available. Write for full information on this great line of Sensitive Drilling Machines. Built in 1, 2, 3, 4, 6 Spindle Models.

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*Engineered
for
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FOOTBURT
MACHINE TOOLS

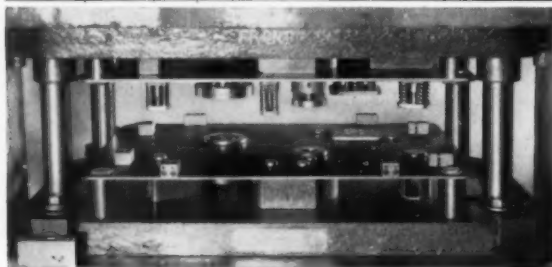
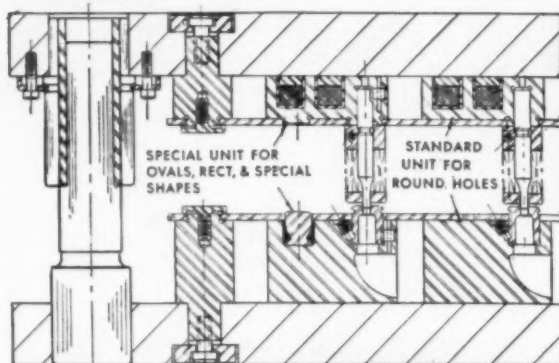
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221

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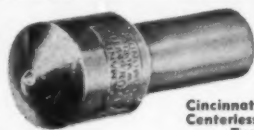
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with **QUICK TRIGGER RELEASE**
for faster
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Note These Features:-

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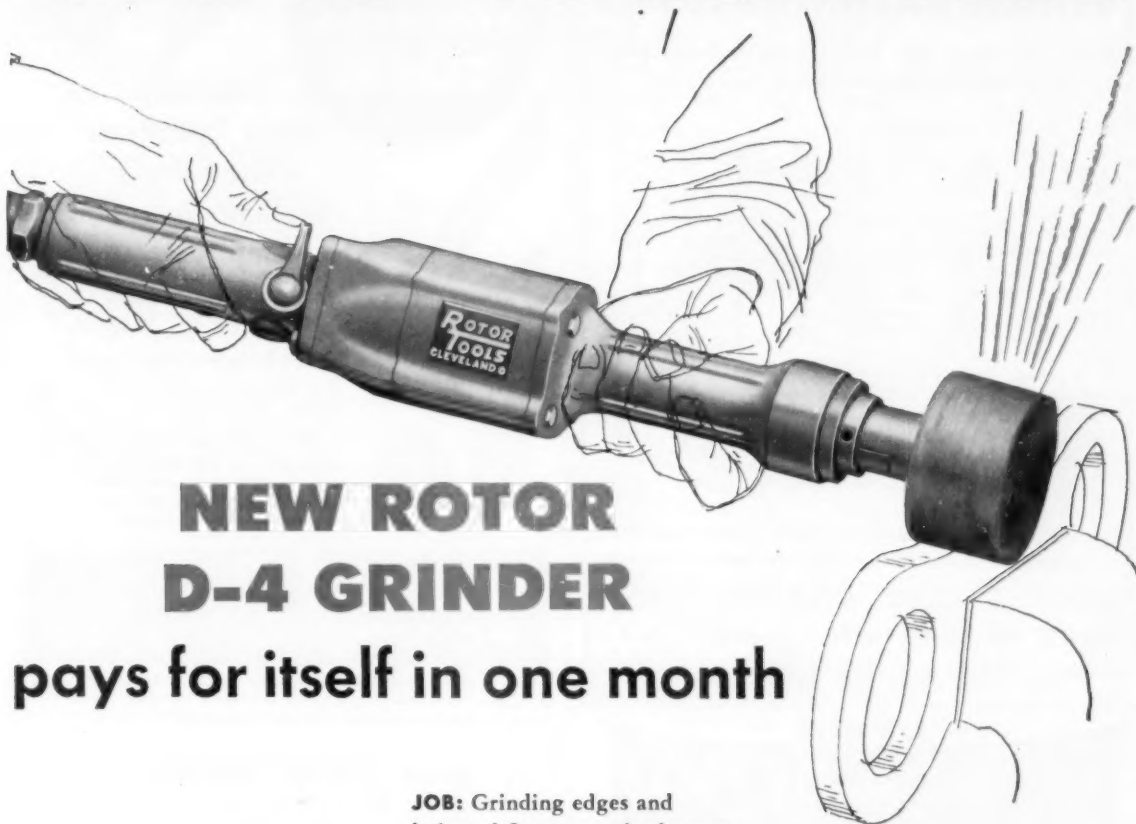
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44% FASTER



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NO. 43

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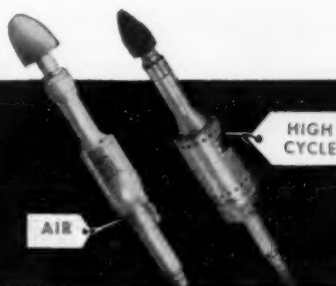
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RESULTS: 44% more output paid off cost of new Rotor Grinders in one month. After that, it's pure savings.

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THE **ROTOR TOOL** CO.
CLEVELAND, OHIO

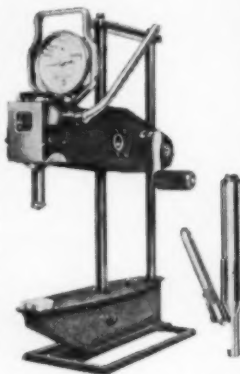
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with more Quality Features



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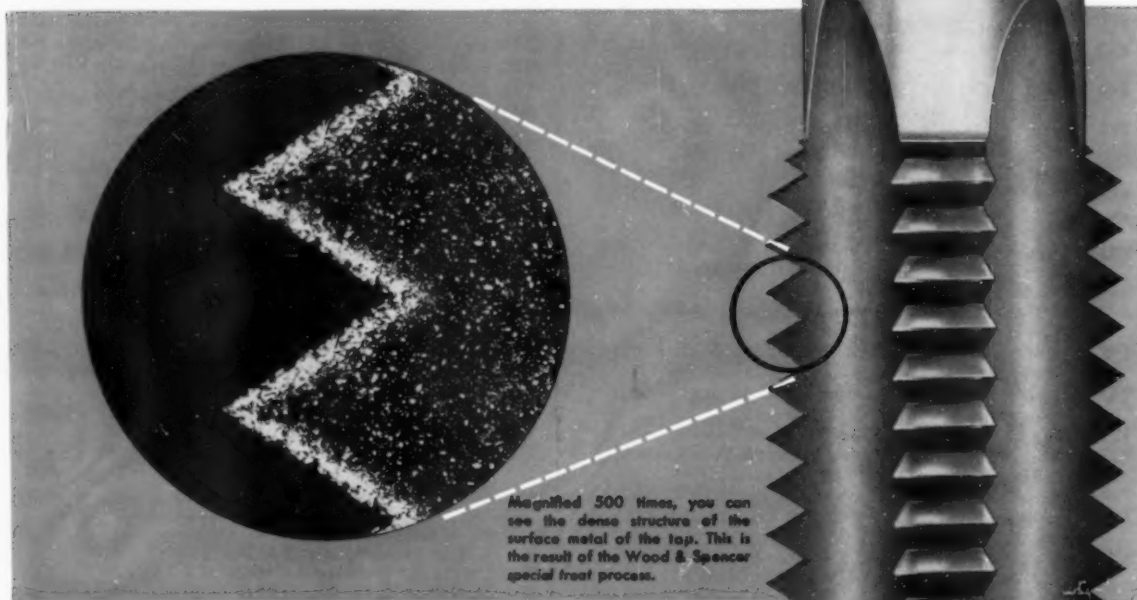
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August 1956

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by



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This step marks an important development in the history of these two companies, universally accepted as leaders in their respective fields.

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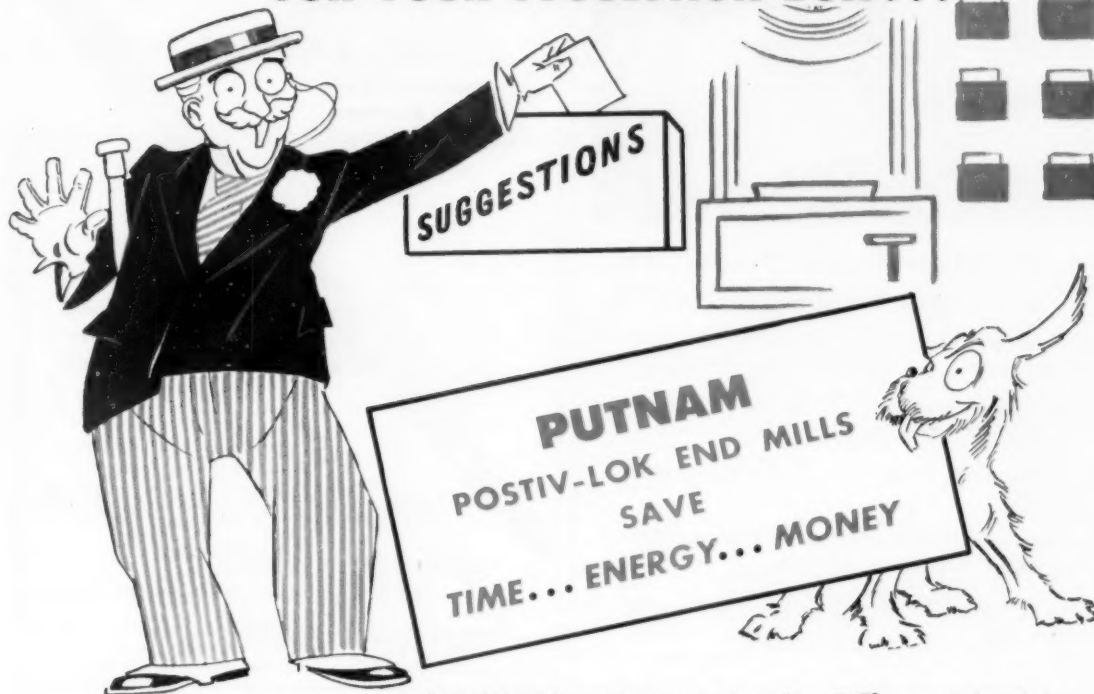
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The Tool Engineer

Here's an Idea

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Postiv-Lok tooling reduces costs as much as 25% or more by eliminating the integral taper shank from large end mills and putting it on a holder. The Postiv-Lok holder soon more than pays for itself through cost savings on end mills. The Postiv-Lok design also assures reduced set-up and change-over time on a machine when production requires switching from one end mill to another.

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Your local Putnam distributor will be happy to discuss tooling problems with you, make recommendations or quickly serve your needs with standard Putnam end mills . . . we suggest you contact him for quality service and use Postiv-Lok on the big jobs for best results.



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IRD
vibration
analyzers

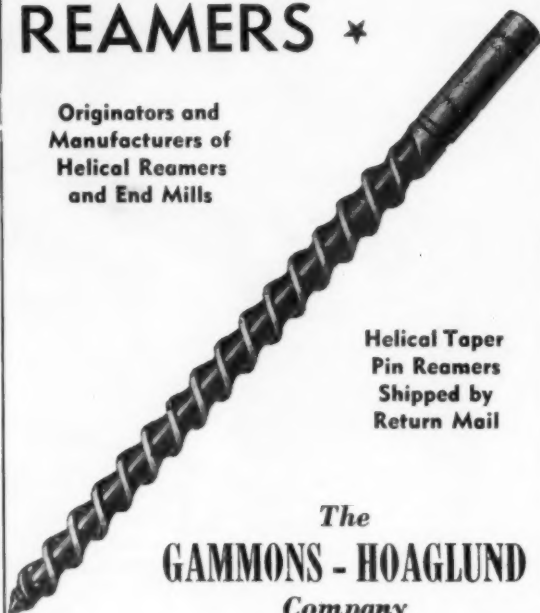
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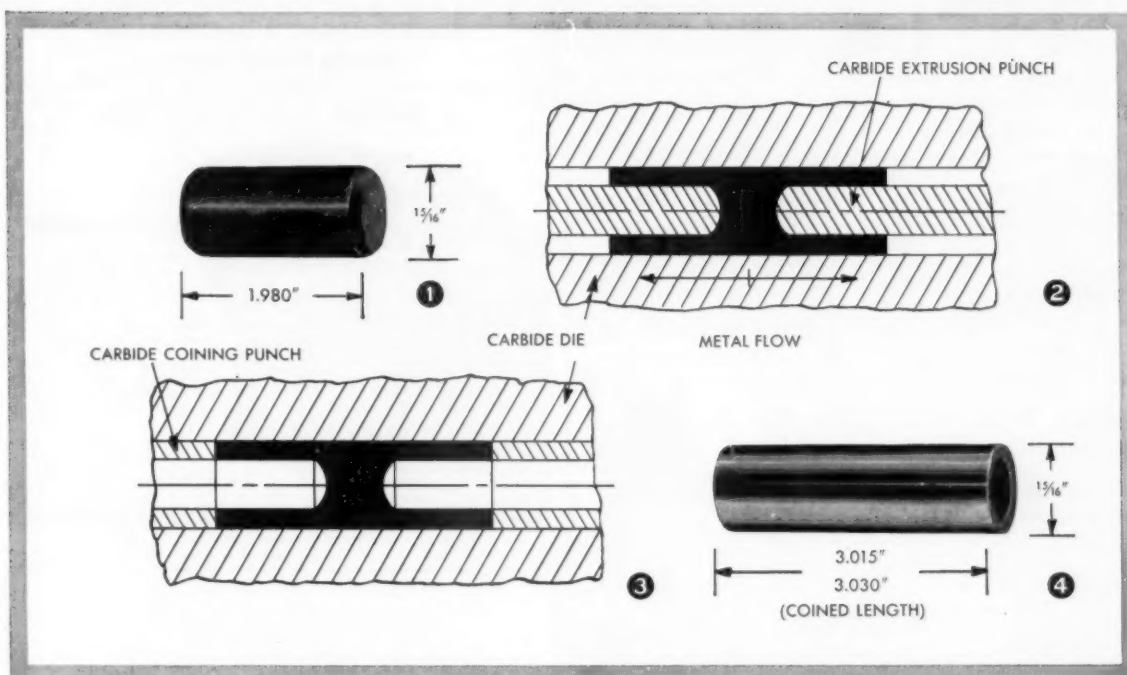
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The Tool Engineer

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Ford Motor Company cold-extrudes steel wrist pins with Carboloy dies



Solid steel slug (1) is cold extruded by opposed carbide punches (2) into correct shape. Carbide coining punches (3) size the pin to correct length, holding $0.015"$ tolerances. Finished pin (4) has the same volume of metal as the original slug. Only metal loss is in finish-grinding operation.

Almost 2000 two-inch steel slugs are cold extruded into three-inch wrist pins every hour at Ford Motor Company's new Cleveland engine plant.

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Cold extrusion with carbide dies and punches can bring these and other benefits to many metalworking companies. Carbide engineers, with years of experience on cold-extrusion problems, are available to help work out specific applications.

To find out if cold extrusion with Carboloy cemented carbide dies is feasible for your application, check with your diemaker, or send your specifications to: *Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Street, Detroit 32, Michigan.*

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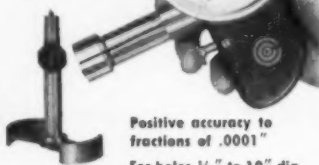
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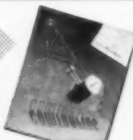
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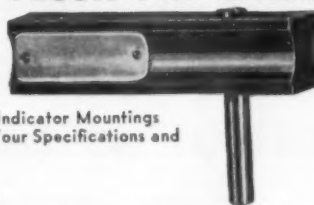
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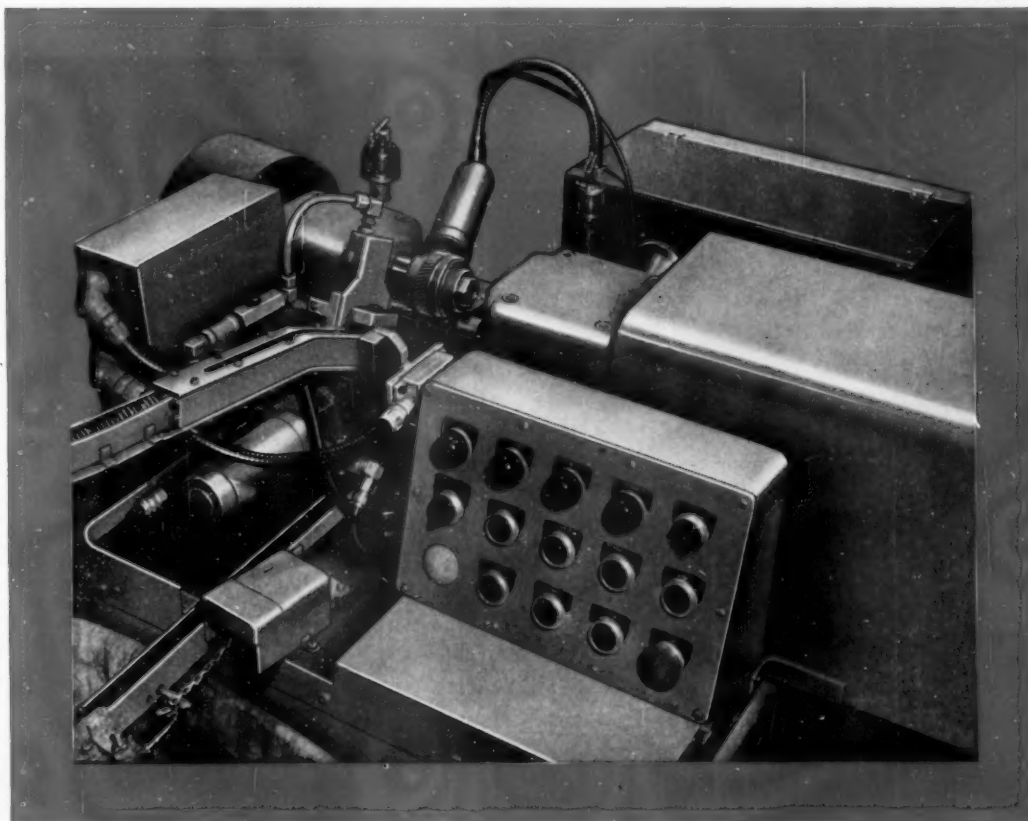


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THE LIFELINE OF AUTOMATION**

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Gage Blocks
at "B" Grade Prices!**



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FREE: DoALL Gage Block Catalog lists square and rectangular sets—5 to 121 pieces—"A", "AA" and new "AAA" grades. Also describes accessories for assembling fixed and indicating gages. Call your local DoALL Store or write for your copy.



The DoALL Company

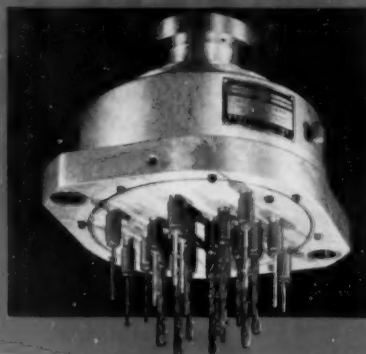
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CENTER

**FOR DRILLING, REAMING
AND TAPPING**



Any hole pattern —
on any center
up to 1½" dia.

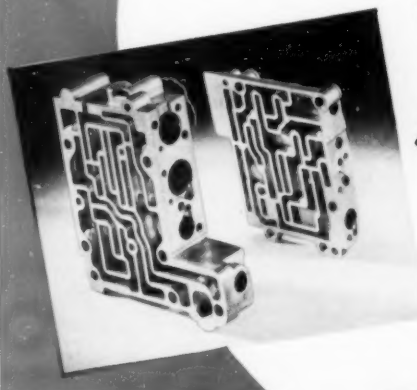
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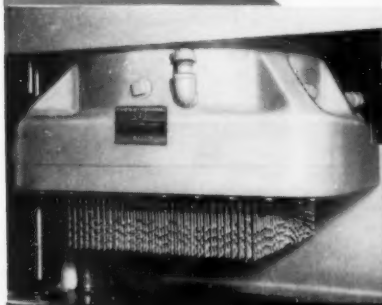
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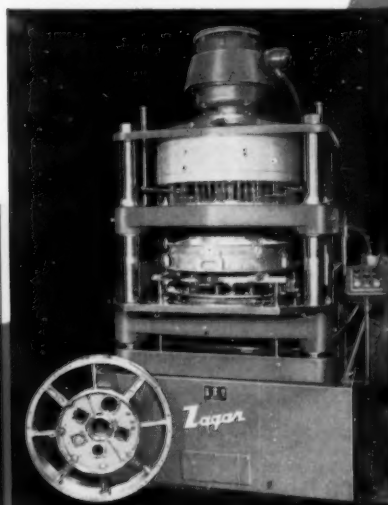
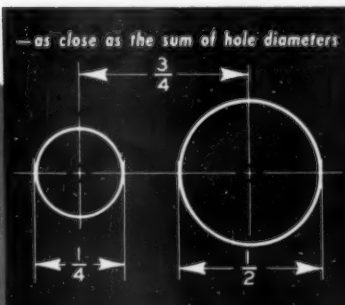
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General Bulletin "E-8".



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material —
from all angles.



Up to 1000 holes can be
drilled IN ONE PASS.



4-post ram-type drilling
machine for aircraft parts.

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August 1956 Issue

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*Exhibitor in 1956 ASTE Industrial Exposition

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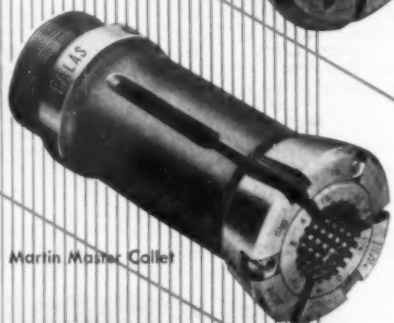
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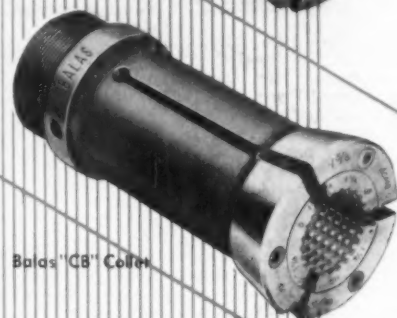
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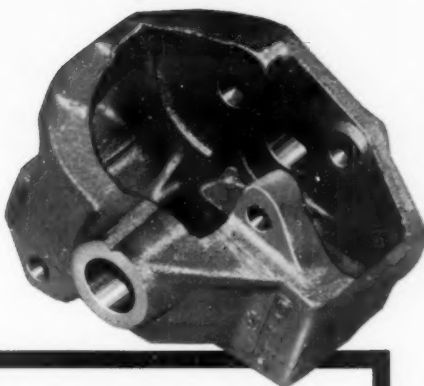
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ABOVE: Gear case after machining. Hole sizes are held within .0005", centers .001".

BELOW: New Style 54 A Precision Two-Way Machine equipped to bore and chamfer cast-iron gear cases. Except for loading, clamping and unloading, this machine is entirely automatic.

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